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National Occupational Analysis

2010 Instrumentation and Control Technician

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Instrumentation and Control Technician

2010

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Trades and Apprenticeship Division
Workplace Partnership Directorate
Human Resources and Skills Development Canada
140 Promenade du Portage, Phase IV, 5th Floor
Gatineau, Quebec K1A 0J9

Fax: 819 953-7260
Online: www.red-seal.ca

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FOREWORD

The Canadian Council of Directors of Apprenticeship (CCDA) recognizes this National Occupational Analysis as the national standard for the occupation of Instrumentation and Control Technician.

Background

The first National Conference on Apprenticeship in Trades and Industries, held in Ottawa in 1952, recommended that the federal government be requested to cooperate with provincial and territorial apprenticeship committees and officials in preparing analyses of a number of skilled occupations. To this end, Human Resources and Skills Development Canada (HRSDC) sponsors a program, under the guidance of the CCDA, to develop a series of National Occupational Analyses (NOA).

The NOAs have the following objectives:

- to describe and group the tasks performed by skilled workers;
- to identify which tasks are performed in every province and territory;
- to develop instruments for use in the preparation of Interprovincial Red Seal Examinations and curricula for training leading to the certification of skilled workers;
- to facilitate the mobility of apprentices and skilled workers in Canada; and,
- to supply employers, employees, associations, industries, training institutions and governments with analyses of occupations.

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LIST OF PUBLISHED NATIONAL OCCUPATIONAL ANALYSES (Red Seal Trades)

TITLES	NOC[1] Code
Agricultural Equipment Technician (2007)	7312
Appliance Service Technician (2005)	7332
Automotive Painter (2009)	7322
Automotive Service Technician (2009)	7321
Baker (2006)	6252
Boilermaker (2008)	7262
Bricklayer (2007)	7281
Cabinetmaker (2007)	7272
Carpenter (2010)	7271
Concrete Finisher (2006)	7282
Construction Electrician (2008)	7241
Construction Craft Worker (2009)	7611
Cook (2008)	6242
Electrical Rewind Mechanic (1999)	7333
Electronics Technician – Consumer Products (1997)	2242
Floorcovering Installer (2005)	7295
Glazier (2008)	7292
Hairstylist (2009)	6271
Heavy Duty Equipment Technician (2009)	7312
Industrial Electrician (2008)	7242
Industrial Mechanic (Millwright) (2009)	7311
Instrumentation and Control Technician (2010)	2243
Insulator (Heat and Frost) (2007)	7293
Ironworker (Generalist) (2006)	7264
Ironworker (Reinforcing) (2006)	7264
Ironworker (Structural/Ornamental) (2006)	7264
Landscape Horticulturist (2010)	2225
Lather (Interior Systems Mechanic) (2007)	7284

[1] National Occupational Classification

Title	NOC* Code
Machinist (2010)	7231
Metal Fabricator (Fitter) (2008)	7263
Mobile Crane Operator (2009)	7371
Motorcycle Mechanic (2006)	7334
Motor Vehicle Body Repairer (Metal and Paint) (2010)	7322
Oil Burner Mechanic (2006)	7331
Painter and Decorator (2007)	7294
Partsperson (2010)	1472
Plumber (2008)	7251
Powerline Technician (2009)	7244
Recreation Vehicle Service Technician (2006)	7383
Refrigeration and Air Conditioning Mechanic (2009)	7313
Rig Technician (2008)	8232
Roofer (2006)	7291
Sheet Metal Worker (2006)	7261
Sprinkler System Installer (2009)	7252
Steamfitter — Pipefitter (2008)	7252
Tilesetter (2004)	7283
Tool and Die Maker (2005)	7232
Transport Trailer Technician (2008)	7321
Truck and Transport Mechanic (2007)	7321
Welder (2009)	7265

Requests for printed copies of National Occupational Analyses may be forwarded to:

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Human Resources and Skills Development Canada
140 Promenade du Portage, Phase IV, 5th Floor
Gatineau, Quebec K1A 0J9

These publications can be ordered or downloaded online at: www.red-seal.ca. Links to Essential Skills Profiles for some of these trades are also available on this website.

STRUCTURE OF ANALYSIS

To facilitate understanding of the occupation, the work performed by tradespersons is divided into the following categories:

Blocks	the largest divisions within the analysis that are comprised of a distinct set of trade activities
Tasks	distinct actions that describe the activities within a block
Sub-Tasks	distinct actions that describe the activities within a task
Key Competencies	activities that a person should be able to do in order to be called 'competent' in the trade

The analysis also provides the following information:

Trends	changes identified that impact or will impact the trade including work practices, technological advances, and new materials and equipment
Related Components	a list of products, items, materials and other elements relevant to the block
Tools and Equipment	categories of tools and equipment used to perform all tasks in the block; these tools and equipment are listed in Appendix A
Context	information to clarify the intent and meaning of tasks
Required Knowledge	the elements of knowledge that an individual must acquire to adequately perform a task

The appendices located at the end of the analysis are described as follows:

Appendix A — Tools and Equipment	a non-exhaustive list of tools and equipment used in this trade
Appendix B — Glossary	definitions or explanations of selected technical terms used in the analysis
Appendix C — Acronyms	a list of acronyms used in the analysis with their full name
Appendix D — Block and Task Weighting	the block and task percentages submitted by each jurisdiction, and the national averages of these percentages; these national averages determine the number of questions for each block and task in the Interprovincial exam
Appendix E — Pie Chart	a graph which depicts the national percentages of exam questions assigned to blocks
Appendix F — Task Profile Chart	a chart which outlines graphically the blocks, tasks and sub-tasks of this analysis

DEVELOPMENT AND VALIDATION OF ANALYSIS

Development of Analysis

A draft analysis is developed by a committee of industry experts in the field led by a team of facilitators from HRSDC. This draft analysis breaks down all the tasks performed in the occupation and describes the knowledge and abilities required for a tradesperson to demonstrate competence in the trade.

Draft Review

The NOA development team then forwards a copy of the analysis and its translation to provincial and territorial authorities for a review of its content and structure. Their recommendations are assessed and incorporated into the analysis.

Validation and Weighting

The analysis is sent to all provinces and territories for validation and weighting. Participating jurisdictions consult with industry to validate and weight the document, examining the blocks, tasks and sub-tasks of the analysis as follows:

BLOCKS	Each jurisdiction assigns a percentage of questions to each block for an examination that would cover the entire trade.
TASKS	Each jurisdiction assigns a percentage of exam questions to each task within a block.
SUB-TASKS	Each jurisdiction indicates, with a YES or NO, whether or not each sub-task is performed by skilled workers within the occupation in its jurisdiction.

The results of this exercise are submitted to the NOA development team who then analyzes the data and incorporates it into the document. The NOA provides the individual jurisdictional validation results as well as the national averages of all responses. The national averages for block and task weighting guide the Interprovincial Red Seal Examination plan for the trade.

This method for the validation of the NOA also identifies common core sub-tasks across Canada for the occupation. If at least 70% of the responding jurisdictions perform a sub-task, it shall be considered common core. Interprovincial Red Seal Examinations are based on the common core sub-tasks identified through this validation process.

Definitions for Validation and Weighting

YES	sub-task performed by qualified workers in the occupation in a specific jurisdiction
NO	sub-task not performed by qualified workers in the occupation in a specific jurisdiction
NV	analysis Not Validated by a province/territory
ND	trade Not Designated in a province/territory
NOT COMMON CORE (NCC)	sub-task, task or block performed by less than 70% of responding jurisdictions; these will not be tested by the Interprovincial Red Seal Examination for the trade
NATIONAL AVERAGE %	average percentage of questions assigned to each block and task in Interprovincial Red Seal Examination for the trade

Provincial/Territorial Abbreviations

NL	Newfoundland and Labrador
NS	Nova Scotia
PE	Prince Edward Island
NB	New Brunswick
QC	Quebec
ON	Ontario
MB	Manitoba
SK	Saskatchewan
AB	Alberta
BC	British Columbia
NT	Northwest Territories
YT	Yukon Territory
NU	Nunavut

ANALYSIS

SAFETY

Safe working procedures and conditions, accident prevention, and the preservation of health are of primary importance to industry in Canada. These responsibilities are shared and require the joint efforts of government, employers and employees. It is imperative that all parties become aware of circumstances that may lead to injury or harm. Safe learning experiences and work environments can be created by controlling the variables and behaviours that may contribute to accidents or injury.

It is generally recognized that safety-conscious attitudes and work practices contribute to a healthy, safe and accident-free work environment.

It is imperative to apply and be familiar with the Occupational Health and Safety (OH&S) Acts and Workplace Hazardous Materials Information System (WHMIS) Regulations. As well, it is essential to determine workplace hazards and take measures to protect oneself, co-workers, the public and the environment.

Safety education is an integral part of training in all jurisdictions. As safety is an imperative part of all trades, it is assumed and therefore it is not included as a qualifier of any activities. However, the technical safety tasks and sub-tasks specific to the trade are included in this analysis.

SCOPE OF THE INSTRUMENTATION AND CONTROL TECHNICIAN TRADE

"Instrumentation and Control Technician" is this trade's official Red Seal occupational title approved by the CCDA. This analysis covers tasks performed by instrumentation and control technicians whose occupational title has been identified by some provinces and territories of Canada under the following names:

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
Industrial Instrument Mechanic			✓	✓			✓			✓		✓	
Industrial Instrument Technician								✓			✓		✓
Instrument Technician									✓				
Instrumentation and Control Technician	✓	✓				✓							

Instrumentation and control technicians work on measuring and controlling instrumentation. They also service plant process control, monitoring, safety and communications systems. They are knowledgeable in overall plant systems and interactions of processes.

Some of the duties of instrumentation and control technicians are:

- consulting diagrams and technical documentation such as schematics, manuals, standards and codes;
- maintaining backups, documentation and software revisions for control systems and instrumentation;
- installing, configuring, calibrating, maintaining and commissioning control, measuring and indicating instrumentation (pneumatic, analog & digital), and wireless and fibre optic;
- configuring and programming Programmable Logic Controllers (PLC), Distributed Control Systems (DCS) and Human Machine Interface (HMI), and Supervisory Control and Data Acquisition (SCADA);
- installing and terminating electrical, pneumatic and fluid connections;
- inspecting and testing the operation of instruments and systems to diagnose faults;
- removing, repairing, adjusting and replacing components;
- calibrating components and systems;
- assisting engineering in plant design, modification and hazard analysis;
- maintaining various computer-based control systems;
- developing and following scheduled maintenance programs;
- keeping up-to-date with advances in technology in industry and the trade;
- working with the plant operators to optimize the plant controls.

Some of the instruments include primary control elements, transmitters, analyzers, sensors, detectors, signal conditioners, recorders, controllers and final control elements. They are used in industry to measure and control variables such as pressure, flow, temperature, level, motion, force and chemical composition.

Instrumentation and control technicians work in various industrial sectors. They may be employed by companies in the following industrial sectors:

- pulp and paper processing;
- nuclear, thermal and hydro power generating;
- mining;
- petrochemical;
- oil and gas;
- steel;
- water treatment;
- manufacturing;
- industrial instrument servicing.

When performing their duties, instrumentation and control technicians must comply with federal, jurisdictional, industrial and site-specific standards, codes and regulations. They must ensure that all processes operate and are maintained within these set standards, codes and regulations.

Instrumentation and control technicians may work in hazardous environments where they may be exposed to confined spaces, heights, noise, dust, cold and heat. There may also be risks working with chemicals, gases, radiation, laser equipment and substances under pressure.

Key attributes for people entering this trade are manual dexterity, ability to pay attention to detail, strong problem solving and communication skills, and mathematical and scientific aptitude.

Instrumentation and control technicians interact with other tradespersons and professionals such as process operators, steamfitters/pipefitters, welders, industrial mechanics (millwrights), electricians and engineers.

With experience, they act as mentors and trainers to apprentices in the trade. They could also move into supervisory, design, advanced control, training or sales positions.

OCCUPATIONAL OBSERVATIONS

The computer is being used for diagnostics, calibration, programming, service and documentation. The use of computerized equipment has raised the level of troubleshooting (diagnosis and repair) ability required by the technician. This has an impact on the education and training requirements for the trade. Continual technical training such as in smart instrumentation, bus networks and software is now common practice.

Hardwired relay systems with microprocessor-based equipment has proven to be more cost-effective and more efficient. Device bus networking is replacing single end run cabling, bringing down the cost of installation as well as being a troubleshooting asset. Wireless based networks for monitoring remote locations, have reduced cabling requirements. This increases transmission speed, distances and data capacity.

There is a demand to utilize the advances in technology in industry which has found its way into almost all aspects of the trade. With this demand, the process of diagnostics and repair continues to evolve placing increase demand on instrument and control technicians to follow the pace of these advances. For example, there is an increase in the use of mass flowmeters for process monitoring and custody transfer. One mass flow transmitter replaces several single variable transmitters, reducing instrumentation and cabling requirements.

Industry practices emissions monitoring for environmental protection supported by governmental regulations. More instrumentation specific to emissions monitoring is being installed. The service of this equipment has become an integral part of the technicians' duties.

Reliability centered maintenance and process safety management including safety instrument systems (SISs) are becoming more common in industry causing a change in focus and duties of instrument and control technicians.

ESSENTIAL SKILLS SUMMARY

Essential skills are needed for work, learning and life. They provide the foundation for learning all other skills and enable people to evolve with their jobs and adapt to workplace change.

Through extensive research, the Government of Canada and other national and international agencies have identified and validated nine essential skills. These skills are used in nearly every occupation and throughout daily life in different ways.

The essential skills profile for the instrumentation and control technician trade indicates that the most important essential skills are **document use**, **oral communication**, **problem solving**, **decision making**, **working with others** and **computer use**.

The application of these skills may be described throughout this document within the competency statements which support each subtask of the trade. The following are summaries of the requirements in each of the essential skills, taken from the essential skills profile. A link to the complete essential skills profile can be found at www.red-seal.ca.

Reading
Instrumentation and control technicians require reading skills to locate and interpret technical information for their trade. Some texts may include technical articles, notes, health and safety bulletins, calibration and service guides, incident reports and procedures manuals.

Document Use
Document use is a significant essential skill for this trade. Instrumentation and control technicians need to be able to locate and interpret information in print and electronic formats. Types of documents include computer printouts with numeric information, supplier catalogue listings and forms, graphs, tables and charts, schematics, assembly diagrams and drawings. They may create documents such as on-site sketches and detailed schematics, assembly drawings, graphs and charts.

Writing
Writing skills are used by instrumentation and control technicians to create parts lists, maintenance schedules, and inspection reports.

Oral Communication
In order to coordinate work, instrumentation and control technicians interact with other tradespeople such as steamfitter/pipefitters, welders, machinists, electricians and industrial mechanics (millwrights). They may also discuss engineering problems with engineers and provide expert advice and opinion. At times, they may make formal presentations to explain quality monitoring or new equipment.

Numeracy
Instrumentation and control technicians must apply measurement and calculation, data analysis and numerical estimation skills to their tasks. Some of these tasks include measuring analyzer malfunctions, calculating air flow, measuring eccentrics, calculating volume displacement, monitoring pressure, interpreting deviations on graphs, and comparing values and measurements.

Thinking Skills
Instrumentation and control technicians take corrective measures to avoid potential hazards and decide such as whether to repair or replace components based on time and cost factors. They plan and organize maintenance schedules, the need for new machinery and assign tradespersons to machinery. They must rely on a significant use of memory to recall locations of various transmitters throughout the plant and what repairs were last carried out. They must also find information to, among other things, monitor pressures and temperatures and synthesize information about machinery.

Working with Others
Even though instrumentation and control technicians often work alone, they may also work with others and liaise with operators. In doing so, they must fill in the role of either team member or team leader on project teams. They liaise with and give information to operators.

Computer Use
Instrument and control technicians use word processing, databases, spreadsheets, communication and vendor software/firmware and computer-assisted design, manufacture or machining to draw information and complete a variety of tasks.

Continuous Learning
Instrumentation and control technicians learn through courses and training such as safety training, confined space training and computer applications relating to process control. They may attend technical courses offered by suppliers' representatives, as well as team leadership/communication seminars. Learning may be done through reading technical magazines and by troubleshooting.

Trends The expectations for safe work practices continue to increase with refined regulations and greater enforcement.

Related Components All components apply.

Tools and Equipment See Appendix A.

Task 1 Organizes work.

Context Instrumentation and control technicians use organizational skills and equipment to perform their tasks in a safe, efficient and effective manner.

Required Knowledge

K 1	symbols and conventions used in schematics and drawings such as Instrumentation, Systems and Automation Society (ISA) standards
K 2	metric and imperial systems
K 3	workplace safety and health regulations such as Workplace Hazardous Materials Information System (WHMIS), Transportation of Dangerous Goods (TDG) and jurisdictional health and safety acts
K 4	pertinent standards and codes such as ISA standards, Canadian Standards Association (CSA) and Canadian Electrical Code (CEC)
K 5	regulations related to environment and measurement
K 6	hazardous area classifications
K 7	types of documentation such as calibration sheets, data sheets and work orders
K 8	maintenance practices such as preventative, predictive and reliability centered programs
K 9	management of change (facility change management) procedures
K 10	trade terminology
K 11	verbal and written communication
K 12	task requirements such as personnel and job plan

K 13	trade equipment and parts
K 14	forms such as bills of material, purchase orders and material requisitions
K 15	workers' rights and responsibilities
K 16	company safety policies and procedures
K 17	training requirements such as fall protection, confined space entry, and hoisting and rigging
K 18	hazards such as nuclear devices, pressures, temperatures, chemicals and voltages
K 19	fire safety and work permit procedures
K 20	housekeeping practices
K 21	emergency procedures and location of safety equipment
K 22	disposal and recycling procedures

Sub-task

A-1.01 Uses drawings and schematics.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Key Competencies

A-1.01.01	identify symbols and interpret drawings and schematics
A-1.01.02	apply drawings and schematics to applications
A-1.01.03	maintain by creating, marking up and updating drawings and schematics according to industry and company standards

Sub-task

A-1.02 Plans tasks.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Key Competencies

A-1.02.01	schedule tasks according to operations, personnel availability, tools and equipment
A-1.02.02	select and acquire required tools, equipment, materials, parts and personnel
A-1.02.03	coordinate with other trades
A-1.02.04	coordinate with operations for process equipment availability and safety
A-1.02.05	select and acquire required personal protective equipment (PPE) and safety equipment
A-1.02.06	apply management of change (facility change management) procedures
A-1.02.07	identify power sources
A-1.02.08	identify stock requirements according to factors such as criticality, operational needs and manufacturers' recommendations
A-1.02.09	prepare site for work by performing activities such as hazard assessment and setting up barricades

Sub-task

A-1.03 Maintains safe work environment.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Key Competencies

A-1.03.01	follow specified safety procedures such as fall arrest, hot work and confined space procedures
A-1.03.02	identify hazards such as high voltage, rotating equipment, nuclear radiation, hazardous gases, working at heights and noisy locations
A-1.03.03	maintain a clean and tidy work site to avoid injuries to self and others
A-1.03.04	coordinate tasks with other workers to avoid injury to self and others
A-1.03.05	use barricades and signage to identify hazards in work areas

A-1.03.06	handle hazardous materials in accordance with WHMIS procedures such as disposal, labelling and using PPE
A-1.03.07	participate in safety meetings and discussions to ensure that information is recorded and distributed to all team members
A-1.03.08	recognize and report unsafe conditions and personal injury hazards so that they may be rectified
A-1.03.09	install safety mechanisms such as double-block-and-bleed, and temporary safety protection

Task 2 Performs routine trade activities.

Context

These tasks are performed across the trade. Instrumentation and control technicians perform routine trade activities in a safe, efficient and effective manner.

These activities can affect the safety, productivity and efficiency of the work site.

Required Knowledge

K 1	PPE such as safety glasses, safety boots, gloves, coveralls and face shields
K 2	safety equipment such as first aid kit, fire extinguishers and eye wash station
K 3	PPE and safety equipment operation and limitations
K 4	the maintenance schedule and certification requirements of PPE and safety equipment
K 5	procedures for shutting down processes
K 6	procedures for isolating equipment from energy sources
K 7	procedures for de-energizing equipment such as electrical, electronic, hydraulic, pneumatic, kinetic and nuclear
K 8	procedures for energizing equipment such as electrical, electronic, hydraulic, pneumatic and nuclear
K 9	types of calibration and test equipment such as multimeters, pressure calibrators and handheld communicators
K 10	types of configuration equipment such as Highway Addressable Remote Transducer (HART) communicator, computers and associated software
K 11	calibration, configuration and test equipment operating procedures and limitations
K 12	the maintenance schedule and certification requirements of calibration, configuration and test equipment

K 13	types of hand tools
K 14	hand tool operating procedures and limitations
K 15	portable and stationary power tool operating procedures and limitations
K 16	types and functions of hoisting and lifting devices such as jacks, hoists and come-alongs
K 17	types and functions of rigging equipment such as belts, ropes, cables and slings
K 18	operating procedures for hoisting and lifting devices
K 19	hoisting and lifting capacities
K 20	material handling equipment including pallet jacks, forklifts, stationary cranes and rigging

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Sub-task

A-2.01 **Uses personal protective equipment (PPE) and safety equipment.**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Key Competencies

A-2.01.01	select and wear PPE appropriate for task and as identified by site policies, jurisdictional regulations and WHMIS
A-2.01.02	inspect PPE for appropriate fit, expiration and damage such as excessively worn boots and cracked safety glasses
A-2.01.03	locate and use safety equipment such as fire extinguishers, eye wash stations and first aid kits
A-2.01.04	store PPE and safety equipment according to manufacturers' recommendations
A-2.01.05	maintain by testing, recertifying or replacing PPE and safety equipment such as safety harnesses, hard hats and lanyards as required by jurisdictional regulations, company policies and manufacturers' recommendations

Sub-task

A-2.02 Performs de-energizing, lockout and tag-out procedures.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Key Competencies

A-2.02.01	identify sources of potential energy such as suspended weight, trapped pressure, electrical potential and nuclear devices
A-2.02.02	select isolation points such as valves, brakes and motor control center (MCC) to ensure that energy cannot be added to the system
A-2.02.03	de-energize system using methods such as relieving pressure, applying grounds and releasing brakes
A-2.02.04	perform lockout according to company and jurisdictional regulations and legislation
A-2.02.05	record equipment lockout specifics for future reference

Sub-task

A-2.03 Maintains calibration, configuration and test equipment.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Key Competencies

A-2.03.01	inspect and test calibration and test equipment
A-2.03.02	inspect and verify functionality of configuration equipment
A-2.03.03	confirm versions of software and firmware and perform updates when required
A-2.03.04	recertify calibration and test equipment and devices according to manufacturers' recommendations, regulations and company policies
A-2.03.05	store calibration, configuration and test equipment according to manufacturers' recommendations and company policies
A-2.03.06	maintain documentation of maintenance and certification of calibration, configuration, revision control and test equipment

Sub-task

A-2.04 Maintains tools.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Key Competencies

A-2.04.01	inspect hand tools for damage
A-2.04.02	lubricate hand tools such as flaring tools and cutters to ensure proper operation
A-2.04.03	wipe tools after use to ensure they are clean and rust-free
A-2.04.04	replace hand tool parts such as cutting blades and hacksaw blades
A-2.04.05	check batteries and chargers to ensure they are in good condition and batteries are fully charged
A-2.04.06	clean and inspect power tools for unsafe conditions such as missing, worn and damaged parts, defective or missing guards and frayed cords
A-2.04.07	replace power tool components such as drill bits and cutting discs
A-2.04.08	repair defective components of power tools
A-2.04.09	store tools in a clean and dry location to ensure they are in operating condition

Sub-task

A-2.05 Operates material handling equipment.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Key Competencies

A-2.05.01	identify weight of lift and capacity of available equipment
A-2.05.02	select material handling equipment according to type of lift and weight
A-2.05.03	identify shop and regulatory limitations and determine what rigging and hoisting operations need to be done by other qualified personnel
A-2.05.04	inspect material handling equipment for defects and expiration dates
A-2.05.05	identify potential hazards such as pinch points, load instability, obstructions and overhead lines

A-2.05.06	isolate work area prior to lift using safety equipment such as barriers and warning lights
A-2.05.07	store equipment in clean and dry locations

BLOCK B PROCESS MEASURING AND INDICATING DEVICES

Trends

Due to the availability of more computing power, sophisticated devices have more functionality and diagnostic capabilities integral within the device, creating in many cases a move to non contact process equipment.

There is a trend towards the use of wireless devices. There is a move to the use of digital bus transmission rather than analog.

Related Components

Pressure measuring devices: pressure gauges, manometers, electronic and pneumatic pressure transmitters, pressure switches.

Temperature measuring devices: thermometers (electronic, infrared, mechanical), thermistors, thermocouples, capillary tubes, resistive thermal devices (RTDs), pyrometers, temperature switches.

Level measuring devices: sight glasses, mechanical level indicators, pneumatic level measuring devices, electronic level measuring devices, level switches.

Flow measuring devices: primary elements (annubars, orifice plates, venturi tubes, pitot tubes, flow nozzles, flumes, weirs, wedge meters, cones), flowmeters (turbine, shedding vortex, magnetic, ultrasonic), flow switches.

Motion, speed, position and vibration measuring devices: probes, amplifiers, proximeters, accelerometers, switches.

Mass and density measuring devices: strain gauges, load cells, scales, paddles/blades, nuclear devices, optical devices, displacers.

Consistency measuring devices: blades, rotary paddles, radar, microwave, optical devices.

Other components: indicators, recorders, controllers, seals and gaskets, fittings, brackets, fasteners, piping, wiring, valves.

Process analyzers: water treatment analyzers (pH, conductivity, dissolved oxygen (DO), turbidity, oxidation reduction potential (ORP) concentration), oil and gas analyzers (chromatograph, spectrometers), environmental analyzers (noise, NO_x, CO_2, H_2S, NH_3 and other greenhouse gases).

Flow computing devices: temperature and pressure differential.

Indicating devices: panel meters, pressure/temperature gauges, sight glasses.

Tools and Equipment See Appendix A.

Task 3 Installs and services pressure, temperature, level and flow measuring and indicating devices.

Context

These primary measuring devices are used to monitor process control variables.

Instrumentation and control technicians install, maintain, diagnose and repair these devices to optimize the control operation. Indicators are used to visually display process variables.

Required Knowledge

K 1	types of pressure and vacuum measuring devices such as pneumatic, electronic and mechanical
K 2	types of level measuring devices such as differential pressure (DP) transmitter, ultrasonic and float switches (mechanical)
K 3	types of flow measuring devices such as DP, positive displacement and ultrasonic
K 4	types of temperature measuring devices such as thermocouples, RTD, filled thermal systems and pyrometers
K 5	types of indicating devices such as chart recorders, digital displays and gauges
K 6	types of pressure such as absolute, differential, gauge, scales and barometric
K 7	temperature scales such as Kelvin, Fahrenheit and Celsius
K 8	types of connections such as piping and wiring
K 9	primary elements for various measuring devices such as orifice plates, turbines and coriolis
K 10	pressure, level and flow calibration instruments such as pressure calibrators, dead weight testers and multimeters
K 11	temperature calibration instruments such as multimeters, temperature baths, dry block calibrators and Wheatstone bridges
K 12	accuracy of calibration instruments
K 13	required calibrating parameters of measuring devices such as zero, span, range, repeatability, specific gravity and accuracy
K 14	calibration methods as required by the measuring device

K 15	interaction of various loops
K 16	measuring device operation
K 17	repair/replacement methods

Sub-task

B-3.01 **Installs pressure, temperature, level and flow measuring and indicating devices.**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Key Competencies

B-3.01.01	select and use tools and equipment according to type of device
B-3.01.02	select device according to process application, environment and company standards
B-3.01.03	select mounting location and mount device according to industry standards and manufacturers' specifications
B-3.01.04	connect device to the process using methods such as tubing, in-line and thermowell according to industry standards
B-3.01.05	terminate wiring to measuring and indicating device(s) according to manufacturers' specifications
B-3.01.06	configure measuring and indicating devices according to manufacturers' instructions, process requirements and/or data sheets
B-3.01.07	calibrate measuring and indicating devices according to manufacturers' instructions, process requirements and/or data sheets
B-3.01.08	verify operation of device within specified parameters by using test equipment and procedures
B-3.01.09	modify enclosures and panels to hold devices and indicators
B-3.01.10	back up and document configuration settings for future data recovery

Sub-task

B-3.02 **Maintains pressure, temperature, level and flow measuring and indicating devices.**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Key Competencies

B-3.02.01	perform inspection to detect abnormalities such as leaks, loose connections and corrosion
B-3.02.02	perform function check of device to confirm proper operation
B-3.02.03	clear sensing lines of the measuring and indicating devices by isolating, equalizing or blowing down, to ensure lines are not plugged
B-3.02.04	follow manufacturers' recommended maintenance practices
B-3.02.05	clean devices using materials such as solvents, fine wire, abrasives and contact cleaners
B-3.02.06	verify calibration of devices before returning to service

Sub-task

B-3.03 **Diagnoses pressure, temperature, level and flow measuring and indicating devices.**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Key Competencies

B-3.03.01	select and use diagnostic tools and equipment such as computer and software and hand-held configurator
B-3.03.02	perform inspection to detect faults such as leaks, physical damage and poor wiring connections
B-3.03.03	perform function check of device to isolate problems such as plugged sensing line and inadequate power
B-3.03.04	determine probable root cause and location of faults

Sub-task

B-3.04 **Repairs pressure, temperature, level and flow measuring and indicating devices.**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Key Competencies

B-3.04.01	select and use tools and equipment such as digital multimeter, pressure calibrator and test gauges
B-3.04.02	select replacement components required according to codes and manufacturers' specifications
B-3.04.03	replace components such as sensor boards, LCDs and bellows
B-3.04.04	clear plugged lines
B-3.04.05	inspect and clean process-wetted components where device contacts the process

Task 4 — Installs and services motion, speed, position and vibration measuring and indicating devices.

Context These measuring devices sense motion, speed, position and vibration and enable the instrumentation and control technician to monitor the operation of equipment. These devices are usually installed, maintained and repaired to protect the integrity of the equipment.

Required Knowledge

K 1	motion and position/displacement measuring devices such as torque switches, proximity switches, proximity probes and analog position sensors
K 2	speed measuring devices such as tachometers, strobes and proximeters
K 3	vibration measuring devices such as probes and proximeters
K 4	types of indicating devices such as chart recorders, digital displays and gauges
K 5	motion, speed, position and vibration calibration instruments such as strobe lights, multimeters and tachometers
K 6	manufacturers' specifications

K 7	required calibrating parameters of measuring devices such as zero, span, range and accuracy
K 8	relevant laws and principles of physics such as speed and velocity
K 9	measuring device operation
K 10	materials such as solvents and contact cleaners

Sub-task

B-4.01 **Installs motion, speed, position and vibration measuring and indicating devices.**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Key Competencies

B-4.01.01	select and use tools and equipment such as mini-wrenches and feeler gauges according to type of device
B-4.01.02	select device according to process application, environment and company standards
B-4.01.03	select cable according to manufacturers' specifications
B-4.01.04	select mounting location and hardware according to manufacturers' specifications
B-4.01.05	mount device using methods such as bolting, welding and threading
B-4.01.06	terminate wiring to measuring and indicating device(s) according to manufacturers' specifications
B-4.01.07	configure and calibrate devices according to manufacturers' instructions to match sensors to receivers
B-4.01.08	verify operation of device within specified parameters by using test equipment and procedures
B-4.01.09	back up and document configuration settings for future data recovery

Sub-task

B-4.02 **Maintains motion, speed, position and vibration measuring and indicating devices.**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Key Competencies

B-4.02.01	perform inspection to detect abnormalities such as dirt, loose connections and corrosion
B-4.02.02	perform function check of device to confirm proper operation
B-4.02.03	follow manufacturers' recommended maintenance practices
B-4.02.04	clean components such as optical lenses and probe faces using materials such as solvents, abrasives and contact cleaners
B-4.02.05	verify calibration of devices and recalibrate if necessary before returning to service

Sub-task

B-4.03 **Diagnoses motion, speed, position and vibration measuring and indicating devices.**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Key Competencies

B-4.03.01	select and use diagnostic tools and equipment such as oscilloscope, multimeter and hand-held configurator
B-4.03.02	perform inspection to detect faults such as misalignment, physical damage and poor electrical connections
B-4.03.03	perform function check of device to isolate problems such as dirty optics, faulty sensors and inadequate power
B-4.03.04	determine probable root cause and location of faults

Sub-task

B-4.04 **Repairs motion, speed, position and vibration measuring and indicating devices.**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Key Competencies

B-4.04.01	select and use tools and equipment such as multimeters, feeler gauges and tachonometer
B-4.04.02	select replacement components required according to codes and manufacturers' specifications
B-4.04.03	remove and replace components such as sensors, sensor boards, reflectors and transmitters
B-4.04.04	inspect and clean components such as reflectors and lenses

Task 5 Installs and services mass, density and consistency measuring and indicating devices.

Context These devices measure the characteristics of the material within the process. These devices are more complex and specialized and are tailored to match the process. These devices must be properly installed and maintained in order to maintain product quality.

Required Knowledge

K 1	types of mass measuring devices such as load cells, scales and strain gauges
K 2	types of density measuring devices such as u-tube, displacer, nuclear gauge and refractometer
K 3	radiation safety practices
K 4	types of consistency measuring devices such as optical, rotary, blade, paddle and microwave
K 5	types of indicating devices such as chart recorders, digital displays and gauges
K 6	factors affecting system performance such as temperature, vibration and pressure

K 7	types of connections such as piping and wiring
K 8	calibration instruments such as multimeters, refractometers, radiation survey meters and calibrated standards
K 9	accuracy of calibration equipment
K 10	required calibrating parameters of measuring devices such as zero, span, range, repeatability and specific gravity
K 11	calibration methods as required by the measuring device
K 12	interaction of various loops
K 13	measuring device operation
K 14	repair/replacement methods

Sub-task

B-5.01 **Installs mass, density and consistency measuring and indicating devices.**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Key Competencies

B-5.01.01	select and use tools and equipment according to type of device
B-5.01.02	select device according to process application, environment and company standards
B-5.01.03	select mounting location and hardware according to industry standards and manufacturers' specifications
B-5.01.04	mount device and connect to the process using methods such as in-line, screwing, bolting and tubing according to industry standards
B-5.01.05	terminate wiring to measuring and indicating device(s) according to manufacturers' specifications
B-5.01.06	configure measuring and indicating devices according to manufacturers' instructions, process requirements and/or data sheets
B-5.01.07	calibrate measuring and indicating devices according to manufacturers' instructions, process requirements and/or data sheets
B-5.01.08	verify operation of device within specified parameters by using test equipment and procedures
B-5.01.09	back up and document configuration settings for future data recovery

Sub-task

B-5.02 **Maintains mass, density and consistency measuring and indicating devices.**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Key Competencies

B-5.02.01	perform inspection to detect abnormalities such as leaks, loose connections and corrosion
B-5.02.02	perform function check of device to confirm proper operation
B-5.02.03	follow manufacturers' recommended maintenance practices
B-5.02.04	clean devices using materials such as solvents, fine wire, abrasives and contact cleaners
B-5.02.05	verify calibration of devices and recalibrate if necessary before returning to service

Sub-task

B-5.03 **Diagnoses mass, density and consistency measuring and indicating devices.**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Key Competencies

B-5.03.01	select and use diagnostic tools and equipment such as multimeter, computers and software, and hand-held configurator
B-5.03.02	perform inspection to detect faults such as leaks, misalignment, physical damage and poor electrical connections
B-5.03.03	check function of device to isolate problems such as dirty lenses, faulty sensors and inadequate power
B-5.03.04	determine probable root cause and location of faults

Sub-task

B-5.04 **Repairs mass, density and consistency measuring and indicating devices.**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Key Competencies

B-5.04.01	select and use tools and equipment such as multimeter and test weights
B-5.04.02	replace components such as sensors and sensor boards
B-5.04.03	inspect and clean components such as reflectors and lenses
B-5.04.04	rebuild devices such as rotary consistency transmitters and mechanical belt scales

Task 6 Installs and services process analyzers.

Context Process analyzers are used to measure and verify that processes are working correctly and following quality control and regulatory standards. Instrumentation and control technicians must be able to install, maintain, diagnose and repair process analyzers to maintain process quality and to protect the environment and workers.

Required Knowledge

K 1	process analyzers such as pH, conductivity, turbidity and ORP
K 2	quality control analyzers such as chromatographs, spectrometers and pulp quality analyzers
K 3	environmental emission analyzers such as for noise, hazardous gases and greenhouse gases
K 4	types of connections such as piping, wiring and flange-mounted
K 5	operational theory of analyzers
K 6	operating parameters such as sampling time, analysis time and measurement limitations
K 7	required installation conditions such as ambient temperature and cleanliness
K 8	sampling systems, conditioners and methods

K 9	calibration instruments such as lab instruments, multimeters and computer software
K 10	required calibration parameters of analyzers
K 11	calibration material such as inert gases, standard gases, water and oil
K 12	accuracy and repeatability limitations of the analyzer
K 13	calibration methods as required by the analyzer
K 14	interaction of analyzer to process
K 15	possible contamination of analyzers
K 16	maintenance routines and timing
K 17	maintenance materials such as carrier gases
K 18	analyzer operation

Sub-task

B-6.01 **Installs process analyzers.**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Key Competencies

B-6.01.01	select and use tools and equipment such as mounting jigs and calibration samples according to type of device
B-6.01.02	select analyzers according to process application, environmental conditions, manufacturers' specifications and company standards
B-6.01.03	select mounting location and hardware according to industry/company standards and manufacturers' specifications
B-6.01.04	mount device(s) and connect to the process using methods such as in-line and tubing according to manufacturers' instructions and industry standards
B-6.01.05	terminate wiring to measuring and indicating device(s) according to manufacturers' specifications
B-6.01.06	configure analyzer and indicating devices according to manufacturers' instructions, process requirements and/or data sheets
B-6.01.07	calibrate analyzer and indicating devices according to manufacturers' instructions, process requirements and/or data sheets
B-6.01.08	install sampling systems and conditioners

B-6.01.09	verify operation of analyzer and sampling system within specified parameters by using test equipment, sampling routines and procedures
B-6.01.10	back up and document configuration settings for future data recovery

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Sub-task

B-6.02 Maintains process analyzers.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Key Competencies

B-6.02.01	perform inspection to detect abnormalities such as leaks, incorrect sample flow and corrosion
B-6.02.02	check function of analyzer and sampling system to confirm proper operation
B-6.02.03	follow and modify (as required) manufacturers' recommended maintenance practices and schedules
B-6.02.04	clean devices using materials such as solvents, fine wire, abrasives and contact cleaners
B-6.02.05	clear sample lines by flushing, rodded, or steamed to prevent build-up of process material
B-6.02.06	verify calibration of devices and recalibrate if necessary before return to service

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Sub-task

B-6.03 Diagnoses process analyzers.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Key Competencies

B-6.03.01	select and use diagnostic tools and equipment such as multimeter, computers and software, internal diagnostics and hand-held configurator
B-6.03.02	perform inspection to detect errors such as leaks, misalignment, physical damage and faulty electrical connections
B-6.03.03	check function of process analyzer to isolate problems such as dirty optics, faulty sensors and inadequate power

B-6.03.04	select and use supplies such as reference samples and cleaning supplies
B-6.03.05	clean components such as sensors and optics prior to diagnosis
B-6.03.06	determine probable root cause and location of faults

---

Sub-task

B-6.04 Repairs process analyzers.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Key Competencies

B-6.04.01	select and use tools and equipment
B-6.04.02	replace components such as chopper motor, light sources, sensors and sensor boards
B-6.04.03	clean components such as sensors and internal tubing
B-6.04.04	rebuild devices such as regulators and solenoids
B-6.04.05	repair sampling system faults such as plugged sampling lines, faulty solenoids, filters, valves and regulators

Task 7 — Installs and services flow computing devices.

Context

Flow computing devices are stand-alone systems or are integral within measuring devices, SCADA or control systems. They bring in multiple inputs and use these to perform calculations that compensate for variables such as temperature and pressure when calculating mass or actual flow. There are some devices that have many configuration parameters such as product composition and primary flow element specifications.

Instrumentation and control technicians must be able to install, maintain, diagnose and repair flow computing devices to provide accurate flow measurements where a higher degree of accuracy is required. Maintains includes routine preventative maintenance activities.

Required Knowledge

K 1	types and applications of flow computing devices
K 2	operational theory of flow computing devices
K 3	operating parameters
K 4	required installation conditions such as ambient temperature and location
K 5	pressure and temperature calibration instruments such as pressure calibrators, multimeters and computer software
K 6	accuracy and repeatability limitations of flow computing devices
K 7	calibration methods as required by the flow computing devices
K 8	accuracy of calibration instruments
K 9	required configuration parameters of flow computing devices as required by application and industry standards
K 10	repair/replacement methods

Sub-task

B-7.01 **Installs flow computing devices.**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Key Competencies

B-7.01.01	select and use tools and equipment according to type of device
B-7.01.02	select flow computing devices according to process applications, environmental conditions, company standards and manufacturers' specifications
B-7.01.03	select mounting location and hardware according to industry standards and manufacturers' specifications
B-7.01.04	terminate wiring to flow computing devices from measuring device(s) according to manufacturers' specifications
B-7.01.05	configure flow computing devices according to manufacturers' instructions, application and/or data sheets
B-7.01.06	calibrate flow computing devices according to manufacturers' instructions, process requirements and/or data sheets
B-7.01.07	verify operation of flow computing devices within specified parameters by using test equipment and procedures
B-7.01.08	back up and document configuration settings for future data recovery

Sub-task

B-7.02 Maintains flow computing devices.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Key Competencies

B-7.02.01	calibrate flow computing devices during routine maintenance according to manufacturers' instructions, regulatory requirements, process requirements and/or data sheets
B-7.02.02	upgrade software and firmware as required to avoid obsolescence and make sure that values are consistent with current standards
B-7.02.03	follow manufacturers' recommended maintenance practices and schedules
B-7.02.04	document configurations and calibrations to comply with regulatory requirements and to facilitate maintenance activities

Sub-task

B-7.03 Diagnoses flow computing devices.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Key Competencies

B-7.03.01	select and use diagnostic tools and equipment such as multimeter, computers and software, internal diagnostic tools and hand-held configurator
B-7.03.02	perform inspection to detect errors such as faulty electrical connections and incorrect readings
B-7.03.03	check function of flow computing device to identify problems such as loss of power and communication
B-7.03.04	determine probable root cause and location of faults

Sub-task

B-7.04 Repairs flow computing devices.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Key Competencies

B-7.04.01	select and use tools and equipment
B-7.04.02	replace components such as circuit boards, power supplies and displays
B-7.04.03	confirm restored configurations

BLOCK C SAFETY AND SECURITY SYSTEMS AND DEVICES

Trends	Due to safety awareness, there is an increase in the use of personal, property and environmental protection equipment as well as security systems.
Related Components (include, but not limited to)	**Safety systems**: gas (infrared, electro-chemical cells and catalytic bead), flame (ultraviolet and infrared), heat (thermal pencils and heat sensors), smoke (ionic and particle detectors), spill detection and water quality. **Personal protection devices**: portable gas detectors, radiation badges **Security systems**: intruder alerts, remote monitoring, cameras, motion sensors, access systems.
Tools and Equipment	See Appendix A. **Specialized equipment**: carrier gases, standard samples, software, leak detectors.

Task 8 Installs and services safety systems and devices.

Context

Safety systems and devices are used to detect and react to hazards such as gas leaks, fires and spills. Reactions may range from alarms to plant shutdowns and evacuations. The proper installation, calibration and maintenance of these systems are imperative to the safety of plant, personnel and environment.

Required Knowledge

K 1	types of gas detection equipment such as infrared and electrolytic
K 2	types of flame detection equipment such as ultraviolet, infrared and magnetic
K 3	types of heat detection equipment such as thermal pencils and heat sensors
K 4	types of smoke detection equipment such as ionic and particle detectors
K 5	types of leak detection equipment such as oil in water and oil on water
K 6	types of emission monitoring equipment for conditions such as effluent pH, stack emissions, turbidity of water
K 7	hazardous gases such as chlorine, H_2S and phosgene

K 8	types of personal protection devices such as portable gas detectors, breathing air systems and radiation badges
K 9	acceptable limits according to codes for conditions such as oxygen levels, H_2S levels, radiation levels and water quality
K 10	shutdown procedures, actions and implications
K 11	calibration instruments such as multimeters and configuration software
K 12	required calibrating parameters of safety systems
K 13	maintenance materials such as test gas and filters
K 14	accuracy limitations of safety systems
K 15	calibration methods as required by the safety systems
K 16	interaction of safety system to process
K 17	maintenance routines
K 18	safety system operation

Sub-task

C-8.01 Installs safety systems and devices.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	ND	no	yes	yes	yes	yes	NV	NV	NV

Key Competencies

C-8.01.01	identify hazard or emission to be detected
C-8.01.02	determine location for the detection system and devices according to manufacturers' instructions and industry standards and codes
C-8.01.03	select and use tools and equipment
C-8.01.04	select safety system for process applications, industry standards and codes
C-8.01.05	select mounting hardware for the system and devices
C-8.01.06	mount device according to manufacturers' instructions and industry standards and codes
C-8.01.07	configure system according to codes and manufacturers' specifications
C-8.01.08	select and use standard samples to verify system and devices
C-8.01.09	verify operation of safety systems and devices within specified parameters by using test equipment and procedures
C-8.01.10	back up and document configuration settings for future data recovery

Sub-task

C-8.02 Maintains safety systems and devices.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Key Competencies

C-8.02.01	select test equipment and material such as UV/IR source test gas, filter and smoke generator to verify protection system or device
C-8.02.02	verify systems according to jurisdictional regulations and manufacturers' specifications for proper operation
C-8.02.03	verify PPE according to jurisdictional regulations and manufacturers' specifications for proper operation using methods such as bump testing and calibrating portable gas detectors
C-8.02.04	calibrate safety systems and devices according to manufacturers' instructions, process requirements and/or data sheets

Sub-task

C-8.03 Diagnoses safety systems and devices.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Key Competencies

C-8.03.01	select test equipment and materials such as gas, smoke generator, multimeter and colorimeter
C-8.03.02	determine components to be replaced
C-8.03.03	identify probable root cause and location of faults
C-8.03.04	determine steps required to repair fault

Sub-task

C-8.04 **Repairs safety systems and devices.**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Key Competencies

C-8.04.01	select and use tools and equipment such as multimeter, test gas and smoke generator
C-8.04.02	select replacement components required according to codes and manufacturers' specifications
C-8.04.03	replace faulty components

Task 9 Installs and services security systems. (NOT COMMON CORE)

Context Security systems are used to monitor and alarm security conditions such as intruder alerts. The proper installation and maintenance of these systems are imperative to the safety of facilities and personnel.

Required Knowledge

K 1	types of security systems such as video and card readers
K 2	security system operation
K 3	installation and maintenance requirements such as ambient temperature, location and environmental conditions
K 4	communication networks

Sub-task

C-9.01 Installs security systems. (NOT COMMON CORE)

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	no	no	yes	ND	no	yes	no	no	yes	NV	NV	NV

Key Competencies

C-9.01.01	select type of security system such as closed-circuit TV (CCTV) and intrusion alarm
C-9.01.02	determine location for security system according to environmental conditions, ambient temperature, company standards and legislations
C-9.01.03	select and use tools and equipment
C-9.01.04	select mounting hardware for system and devices
C-9.01.05	mount and connect system components according to manufacturers' specifications and company standards
C-9.01.06	configure system according to manufacturers' specifications and company standards
C-9.01.07	verify operation of security system within specified parameters by using test equipment and procedures
C-9.01.08	back up and document configuration settings for future data recovery

Sub-task

C-9.02 Maintains security systems. (NOT COMMON CORE)

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	no	no	yes	ND	yes	yes	no	no	yes	NV	NV	NV

Key Competencies

C-9.02.01	conduct inspection of system components
C-9.02.02	verify system operation
C-9.02.03	clean security system components such as camera lenses and covers

Sub-task

C-9.03 Diagnoses security systems. (NOT COMMON CORE)

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	no	yes	yes	ND	yes	yes	no	no	yes	NV	NV	NV

Key Competencies

C-9.03.01	select and use tools and equipment such as multimeter and hand-held camera/monitor
C-9.03.02	select and use diagnostic software to determine system faults
C-9.03.03	identify probable root cause and location of faults
C-9.03.04	determine steps required to repair faults

Sub-task

C-9.04 Repairs security systems. (NOT COMMON CORE)

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	no	yes	yes	ND	yes	yes	no	no	yes	NV	NV	NV

Key Competencies

C-9.04.01	select and use tools and equipment such as multimeter and hand-held camera/monitor
C-9.04.02	select replacement components required according to manufacturers' specifications
C-9.04.03	replace faulty components and devices

BLOCK D HYDRAULIC, PNEUMATIC AND ELECTRICAL SYSTEMS

Trends

Because of a trend to reduce emissions, devices are more energy efficient. As such, there is a move away from using natural gas as a medium for pneumatic source of power.

Environmental concerns are resulting in a decrease in the use of hydraulic systems around sensitive areas such as water to prevent potential contamination.

Industry is still moving away from component repair to board replacement.

Related Components (include, but not limited to)

Hydraulic equipment: hydraulic fluids and filters, pumps, control valves, regulators, safety valves.

Pneumatic equipment: air dryers, conditioning components (filter assemblies, volume boosters), compressors, regulators, safety valves.

Electrical equipment: alternating current/direct current (AC/DC) power supplies, uninterruptible power supplies (UPS), circuit boards, transformers.

Tools and Equipment

See Appendix A.

Task 10 Installs and services hydraulic equipment.

Context

Hydraulic equipment is used to supply energy and to control equipment and processes through the use of liquids. Hydraulic equipment is used for higher pressure applications. Instrumentation and control technicians install and maintain hydraulic equipment.

Required Knowledge

K 1	hydraulic theories, specifications and hazards
K 2	types of hydraulic equipment, components and devices such as pumps, filters and regulators
K 3	temperature ratings for types of hydraulic oils such as synthetic and conventional

K 4	hydraulic equipment operation
K 5	repair/replacement methods
K 6	cleanliness standards required for hydraulic systems

Sub-task

D-10.01 Installs hydraulic equipment. (NOT COMMON CORE)

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	no	yes	ND	no	no	yes	no	yes	NV	NV	NV

Key Competencies

D-10.01.01	determine system requirements such as pressure, volume and storage
D-10.01.02	select components according to system requirements
D-10.01.03	select and use tools and equipment
D-10.01.04	determine location of system equipment according to manufacturers' recommendations and company standards
D-10.01.05	connect system components such as solenoids, accumulators, servo-valves, motors and pumps
D-10.01.06	verify operation of hydraulic equipment within specified parameters by using test equipment and procedures

---

Sub-task

D-10.02 Maintains hydraulic equipment.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	no	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Key Competencies

D-10.02.01	select and use tools and equipment such as infrared thermometer, pressure gauge and vibration meter
D-10.02.02	inspect system according to specifications and maintenance schedule for conditions such as leaks, fluid levels and vibrations
D-10.02.03	verify system operating parameters such as pressure and temperature

D-10.02.04 collect hydraulic fluids for sampling according to maintenance schedule

D-10.02.05 top up fluid levels and change filters according to maintenance schedule

---

Sub-task

D-10.03 Diagnoses hydraulic equipment.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Key Competencies

D-10.03.01 select and use diagnostic tools and equipment such as temperature sensor, pressure gauge and vibration meter

D-10.03.02 identify probable root cause and location of faults

D-10.03.03 determine steps required to repair faults

Sub-task

D-10.04 Repairs hydraulic equipment.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Key Competencies

D-10.04.01 select and use tools and equipment

D-10.04.02 select replacement components required according to system specifications and applications

D-10.04.03 repair faulty system components according to job procedure and manufacturers' recommendations

D-10.04.04 install replacement components according to system specifications and applications

D-10.04.05 clean dirty components such as servo-valves and relief valves

Task 11 — Installs and services pneumatic equipment.

Context

Pneumatic equipment is used to supply energy and to control equipment and processes through the use of various compressed gases. Instrumentation and control technicians install and maintain pneumatic equipment.

Required Knowledge

K 1	pneumatic theories, specifications and hazards
K 2	types of pneumatic equipment, components and devices such as compressors, air dryers, safety valves and regulators
K 3	compressed gas qualities such as dew point, presence of particulates and oil contamination
K 4	pneumatic equipment operation
K 5	repair/replacement methods
K 6	combustible gases and venting practices

Sub-task

D-11.01 Installs pneumatic equipment.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	no	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Key Competencies

D-11.01.01	determine system requirements such as pressure, volume and storage
D-11.01.02	select components according to system requirements
D-11.01.03	select and use tools and equipment
D-11.01.04	determine location of system equipment according to manufacturers' recommendations and company standards
D-11.01.05	connect system components such as regulators, separators and tubing
D-11.01.06	calibrate pneumatic equipment such as pressure switches, regulators and gauges
D-11.01.07	verify operation of pneumatic equipment within specified parameters by using test equipment and procedures

Sub-task

D-11.02 Maintains pneumatic equipment.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	no	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Key Competencies

D-11.02.01	select and use tools and equipment such as infrared thermometer, pressure gauge, dew point tester and ultrasonic leak detector
D-11.02.02	inspect and test system according to specifications and maintenance schedule for conditions such as leaks, fluid levels and dew point
D-11.02.03	verify system operating parameters such as pressure and dew point
D-11.02.04	change system components and materials such as filters and desiccant

Sub-task

D-11.03 Diagnoses pneumatic equipment.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Key Competencies

D-11.03.01	select and use tools and equipment such as temperature sensor, pressure gauge and multimeter
D-11.03.02	identify probable root cause and location of faults
D-11.03.03	determine steps required to repair faults

Sub-task

D-11.04 Repairs pneumatic equipment.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Key Competencies

D-11.04.01	select and use tools and equipment
D-11.04.02	select replacement components required according to system specifications and applications
D-11.04.03	remove faulty system components according to job procedure and manufacturers' recommendations
D-11.04.04	install replacement components according to system specifications and applications

Task 12 Installs and services electrical equipment.

Context

Electrical equipment is used to supply energy and to control equipment and processes through the use of electricity. Instrumentation and control technicians install and maintain electrical equipment. They work on electrical equipment directly related to process control and often in conjunction with electricians on electrical power supply equipment. Maintains includes routine preventative maintenance activities.

Required Knowledge

K 1	electrical theories, power quality, specifications and hazards
K 2	types of electrical equipment such as AC/DC power supplies and UPS
K 3	electrical equipment operation
K 4	repair/replacement methods
K 5	hazardous locations
K 6	CEC and jurisdictional regulations
K 7	types of batteries and associated hazards

Sub-task

D-12.01 Installs electrical equipment.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	no	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Key Competencies

D-12.01.01	determine system requirements such as voltage, current and power
D-12.01.02	select components according to jurisdictional regulations, system requirements and company standards
D-12.01.03	select tools and equipment
D-12.01.04	determine location of system equipment according to jurisdictional regulations, system requirements and company standards
D-12.01.05	connect system components such as power supplies, batteries and fuses
D-12.01.06	verify operation of electrical equipment within specified parameters by using test equipment and procedures

Sub-task

D-12.02 Maintains electrical equipment.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	no	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Key Competencies

D-12.02.01	select and use tools and equipment such as multimeter, oscilloscope and clamp-on ammeter
D-12.02.02	inspect system and components according to specifications and maintenance schedule for conditions such as under voltage and over current
D-12.02.03	verify system operating parameters such as voltage and current
D-12.02.04	perform routine battery maintenance activities such as checking voltage level, fluid level and terminal corrosion

Sub-task

D-12.03 Diagnoses electrical equipment.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Key Competencies

D-12.03.01	select and use tools and equipment such as multimeter, hydrometer, oscilloscope and clamp-on ammeter
D-12.03.02	use diagnostic software
D-12.03.03	perform battery load test to indicate conditions of the battery performance
D-12.03.04	identify probable root cause and location of faults
D-12.03.05	determine steps required to repair fault

Sub-task

D-12.04 Repairs electrical equipment.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Key Competencies

D-12.04.01	select and use tools and equipment such as multimeter, oscilloscope and clamp-on ammeter
D-12.04.02	select replacement components such as fuses, batteries, relays cables, according to system specifications, manufacturers' specifications and applications
D-12.04.03	remove faulty system components according to job procedure and manufacturers' recommendations
D-12.04.04	install replacement components according to system specifications and applications

BLOCK E FINAL CONTROL DEVICES

Trends

There is an increase in the use of variable speed drives for motor control. Smart positioners are replacing pneumatic positioners. There is an increased use of diagnostic software to determine and facilitate maintenance.

Related Components (include, but not limited to)

Valves: pinch, globe, plug, gateball, butterfly, v-ball.

Actuators (pneumatic, hydraulic, electric): cylinders, diaphragms, springs, motors.

Positioners (pneumatic, electric/electronic): levers, nozzles, flappers, diaphragms, feedback linkages, I/P transducers, bellows.

Variable speed drives (VSDs)

Other components: tubing, fittings, wiring.

Tools and Equipment

See Appendix A.

Task 13 Installs and services valves.

Context

Valves, in conjunction with actuators and positioners, manipulate the process medium. Valves must be correctly installed and maintained to ensure system efficiency, optimum production and safety of operations and equipment. Maintenance of valves includes routine and preventative maintenance. Diagnosis includes troubleshooting and locating defects such as leaks and wear.

Required Knowledge

K 1	types of valves such as globe, pinch, plug, gateball, butterfly and v-ball
K 2	process equipment operation and performance expectations
K 3	characteristics and applications of valves
K 4	types and applications of packing such as Teflon, graphite and rope
K 5	possible faults of valves such as leaking packing, valve passing and damaged parts
K 6	repair procedures such as disassembly, assembly and replacement of parts

K 7	hazardous process applications
K 8	process requirements

Sub-task

E-13.01 Installs valves.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	no	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Key Competencies

E-13.01.01	select valve to be installed according to application and manufacturers' specifications
E-13.01.02	select and use installation tools and equipment according to application requirements and size of valve
E-13.01.03	select and install gasket material and mounting hardware according to application
E-13.01.04	mount valve using methods such as bolting, welding flanging and threading
E-13.01.05	orientate valve according to manufacturers' specifications in order to prevent premature valve failure and ensure proper function
E-13.01.06	commission system to verify operation within specified parameters by using test equipment and procedures

---

Sub-task

E-13.02 Maintains valves.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	no	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Key Competencies

E-13.02.01	inspect valves according to specifications and maintenance schedule for conditions such as packing leaks and dry shafts
E-13.02.02	lubricate valve stems, bushings and bearings according to manufacturers' specifications
E-13.02.03	verify valve assembly strokes smoothly throughout travel

E-13.02.04	ensure tight shut-off if required
E-13.02.05	record information such as valve stroke, wear and overall condition

---

Sub-task

E-13.03 Diagnoses valves.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Key Competencies

E-13.03.01	select and use diagnostic tools and equipment such as valve diagnostic software, dial gauge and pressure gauge
E-13.03.02	interpret valve signature from diagnostic software to assess conditions such as seat load and sticking valves
E-13.03.03	identify probable root cause and location of fault in valve assembly
E-13.03.04	determine steps required to repair fault

Sub-task

E-13.04 Repairs valves.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Key Competencies

E-13.04.01	select and use tools and equipment such as packing pullers and seat pullers
E-13.04.02	disassemble valve according to job procedure and manufacturers' recommendations
E-13.04.03	select replacement parts such as cage, plug and seat according to valve specifications and applications
E-13.04.04	re-assemble the valve according to job procedure and manufacturers' recommendations

Task 14 Installs and services actuators.

Context Actuators adjust the position of valves. Instrumentation and control technicians install and maintain the actuators to ensure proper operation of valves.

Required Knowledge

K 1	types of actuators such as pneumatic, hydraulic and electric
K 2	applications of actuators such as fail-open and fail-close
K 3	actuator actions such as spring return, double-acting and rotary
K 4	manufacturers' installation specifications
K 5	actuator components such as diaphragms, plates, couplings, springs, bushings and o-rings
K 6	possible faults of actuators such as leaking diaphragms, broken springs and damaged or worn o-rings
K 7	operating environment
K 8	process requirements
K 9	hazardous process applications

Sub-task

E-14.01 Installs actuators.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Key Competencies

E-14.01.01	select actuator to be installed according to application and manufacturers' specifications
E-14.01.02	select and use installation tools and equipment according to application requirements and size of actuator
E-14.01.03	select mounting hardware according to application and manufacturers' specifications
E-14.01.04	orientate and mount actuator according to manufacturers' specifications
E-14.01.05	connect and terminate actuator using methods such as wiring, tubing and bolting according to application requirements

E-14.01.06	benchset actuator to overcome static process pressure and ensure seat load
E-14.01.07	check actuator to verify operation within specified parameters by using test equipment and procedures

---

Sub-task

E-14.02 Maintains actuators.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Key Competencies

E-14.02.01	inspect actuator according to specifications and maintenance schedule for conditions such as damaged diaphragms and o-ring seals
E-14.02.02	lubricate actuator stems, bushings and bearings according to manufacturers' specifications
E-14.02.03	verify that the assembly strokes smoothly throughout travel
E-14.02.04	record information such as valve stroke, wear and overall condition

---

Sub-task

E-14.03 Diagnoses actuators.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Key Competencies

E-14.03.01	select and use diagnostic tools and equipment such as diagnostic software, dial gauge and pressure gauge
E-14.03.02	interpret actuator travel to assess faults such as faulty springs and limits
E-14.03.03	identify probable root cause and location of fault in actuator assembly
E-14.03.04	determine steps required to repair fault

Sub-task

E-14.04 Repairs actuators.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Key Competencies

E-14.04.01	select and use tools and equipment such as spring compressor and seal puller
E-14.04.02	disassemble actuator according to job procedure and manufacturers' specifications
E-14.04.03	select replacement parts required according to actuator specifications and applications
E-14.04.04	reassemble actuator with replacement components such as o-rings, diaphragms and pistons according to job procedure and manufacturers' specifications

Task 15 Installs and services positioners.

Context Positioners are used for the precise positioning of actuators and equipment. They must be properly installed, calibrated and maintained to ensure system efficiency and reliability.

Required Knowledge

K 1	types of positioners
K 2	positioner components such as levers, nozzles, flappers, diaphragms, feedback devices, I/P transducers and bellows
K 3	auxiliaries such as position switches and boosters
K 4	positioner parameters
K 5	diagnostic software

Sub-task

E-15.01 Installs positioners.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Key Competencies

E-15.01.01	select positioner to be installed according to application and manufacturers' specifications
E-15.01.02	select and use installation tools and equipment according to application requirements
E-15.01.03	select mounting hardware according to application
E-15.01.04	orientate and mount positioner to actuator according to manufacturers' specifications
E-15.01.05	connect and terminate positioner using methods such as wiring, tubing and bolting according to application requirements
E-15.01.06	configure and calibrate positioner according to specifications
E-15.01.07	check positioner to verify operation within specified parameters by using test equipment and procedures
E-15.01.08	back up and document configuration settings for future data recovery

Sub-task

E-15.02 Maintains positioners.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Key Competencies

E-15.02.01	inspect positioner according to specifications and maintenance schedule for conditions such as air leaks and feedback faults
E-15.02.02	lubricate and clean positioner components according to manufacturers' specifications
E-15.02.03	verify that the assembly strokes smoothly and does not oscillate throughout travel
E-15.02.04	record information such as valve stroke, wear and overall condition

Sub-task

E-15.03 Diagnoses positioners.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Key Competencies

E-15.03.01	select and use diagnostic tools and equipment such as diagnostic software, dial gauge and pressure gauge
E-15.03.02	verify positioner operation to assess faults such as faulty springs and limits
E-15.03.03	identify probable root cause and location of fault in positioner assembly
E-15.03.04	determine steps required to repair fault

Sub-task

E-15.04 Repairs positioners.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Key Competencies

E-15.04.01	select and use tools and equipment such as configurator and loop calibrator
E-15.04.02	disassemble positioner according to job procedure and manufacturers' specifications
E-15.04.03	select replacement parts required according to positioner specifications and applications
E-15.04.04	reassemble positioner with replacement components such as o-rings, I/P transducer and feedback device according to job procedure and manufacturers' recommendations

Task 16 Services variable speed drives (VSDs).

Context

Variable speed drives are used for the precise control of electric motors. For the purpose of this analysis, VSDs include variable frequency drives (VFD). Instrumentation and control technicians install, configure and maintain VSDs to ensure system efficiency and reliability. Installation is often done in conjunction with industrial electricians.

Required Knowledge

K 1	types of VSDs such as VFDs and DC drives
K 2	VSD parameters and applications such as power requirements, amperage, limitations, and input and output devices
K 3	VSD configurations and interfaces
K 4	diagnostic features of VSDs such as fault codes, error codes

---

Sub-task

E-16.01 Installs VSDs. (NOT COMMON CORE)

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	no	yes	yes	ND	no	no	yes	yes	no	NV	NV	NV

Key Competencies

E-16.01.01	select and use tools and equipment such as computer, software and configurator
E-16.01.02	select VSD according to company st...dards and manufacturers' specifications
E-16.01.03	select mounting location and hardware according to industry standards and manufacturers' specifications
E-16.01.04	terminate wiring to VSDs according to manufacturers' specifications
E-16.01.05	configure and calibrate VSDs according to manufacturers' instructions, application and/or data sheets
E-16.01.06	back up and document configuration settings for future data recovery
E-16.01.07	verify operation of VSD within specified parameters by using test equipment and procedures

Sub-task

E-16.02 Maintains VSDs.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	ND	no	yes	yes	yes	no	NV	NV	NV

Key Competencies

E-16.02.01	select and use tools and equipment such as multimeter, computer and loop calibrator
E-16.02.02	inspect VSDs for abnormal conditions such as contamination and excessive heat
E-16.02.03	verify the inputs and outputs
E-16.02.04	upgrade software and firmware as required to avoid obsolescence and make sure that values are consistent with current standards
E-16.02.05	follow and modify (as required) manufacturers' recommended maintenance practices and schedules
E-16.02.06	document configurations and calibrations to facilitate maintenance activities and for data recovery

---

Sub-task

E-16.03 Diagnoses VSDs.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	ND	no	yes	yes	yes	yes	NV	NV	NV

Key Competencies

E-16.03.01	select and use tools and equipment such as computer, multimeter and configurator
E-16.03.02	interpret VSD fault codes and indicator lights to identify conditions such as overcurrent, under-voltage and ground faults
E-16.03.03	identify probable root cause and location of fault in VSD
E-16.03.04	determine steps required to repair fault

Sub-task

E-16.04 Repairs VSDs. (NOT COMMON CORE)

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	no	yes	yes	ND	no	yes	yes	yes	no	NV	NV	NV

Key Competencies

E-16.04.01	select and use tools and equipment such as computer, software and configurator
E-16.04.02	select replacement parts required according to VSD specifications and applications
E-16.04.03	replace defective components according to job procedure and manufacturers' recommendations

BLOCK F COMMUNICATION SYSTEMS AND DEVICES

Trends	Communication networks such as Ethernet and profibus are becoming more prominent. Wireless communication between devices is an emerging technology for industrial applications. There is a trend to having greater functionality built into the transmitters and the control systems, resulting in fewer stand-alone signal converters. The use of object linking and embedding (OLE) for process control (OPC) is increasing, becoming a standard and eliminating the need for protocol converters.
Related Components (include, but not limited to)	**Network and signal transmission systems**: panels, modems, fibre optic cable, tubing, filters, chips, cards, taps, software and firmware, multiple voltage cabinets, wireless transmission towers, antennas. **Signal converters (digital to analog (D/A), analog to digital (A/D), current to pneumatic, pneumatic to electrical, current transformers, potential transformers, voltage to pneumatic)**: wiring, tubing, connections, chips, cards, software, firmware. **Data converters and gateways**: computer with network cards, proprietary devices.
Tools and Equipment	See Appendix A.

Task 17 Installs and services network and signal transmission systems.

Context Network and signal transmission systems transfer process information and data between nodes and equipment that include electronic, wireless, pneumatic or hydraulic.

Required Knowledge

K 1	types of signal transmission systems such as fibre optics, tubing, wiring and wireless
K 2	communication protocols such as MODBUS, Transport Control Protocol/Internet Protocol (TCP/IP) and HART
K 3	wiring standards such as RS232, RS422/485 and ethernet
K 4	connection methods
K 5	tubing methods
K 6	potential causes of interference
K 7	standards, codes and licences
K 8	features and limitations of protocols and programming languages
K 9	grounding methods
K 10	ground loops
K 11	addressing methods and components
K 12	required wireless signal strength and settings
K 13	foundation Fieldbuses and Profibuses
K 14	security of communication systems and devices
K 15	ISO 9000 and 14000

Sub-task

F-17.01 Installs network and signal transmission systems.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Key Competencies

F-17.01.01	select system components such as switches, repeaters and wiring according to application and environment
F-17.01.02	select and use installation tools and equipment such as cable tester and wire labeller
F-17.01.03	select locations for components such as antennas, switches and routers
F-17.01.04	mount and connect components such as repeaters, fibre optic cable and wiring
F-17.01.05	verify operation of systems within specified parameters by testing signal strength and throughput, and checking error counters

Sub-task

F-17.02 Configures network and signal transmission systems.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Key Competencies

F-17.02.01	select and use tools and equipment such as computer software and hardware
F-17.02.02	set addressing and port parameters according to company standards and documentation
F-17.02.03	back up and document configuration settings for future data recovery

Sub-task

F-17.03 Maintains network and signal transmission systems.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Key Competencies

F-17.03.01	check connections on cabling and tubing
F-17.03.02	select and use software to check error logs, signal strength and counter readings

Sub-task

F-17.04 Diagnoses network and signal transmission systems.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Key Competencies

F-17.04.01	select and use diagnostic tools and equipment such as clamp-on current meters and multimeters
F-17.04.02	perform inspection to detect errors such as leaks, physical damage and faulty connections
F-17.04.03	check status lights to identify abnormal operation
F-17.04.04	verify configuration to ensure no corruption exists
F-17.04.05	identify probable root cause and location of faults
F-17.04.06	check connections on cabling and tubing

Sub-task

F-17.05 **Repairs network and signal transmission systems.**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Key Competencies

F-17.05.01	replace components such as repeaters and power supplies
F-17.05.02	confirm configurations
F-17.05.03	restore systems communication
F-17.05.04	clean connections on fibre optic connectors

Task 18 Installs and services signal converters.

Context

Signal converters convert one form of process information to another that will be understood by the process control system. For example, they may convert A/D signals. They also may convert a type of controlled measurable energy to another, such as electrical to pneumatic. Instrumentation and control technicians install, calibrate and maintain these devices.

Required Knowledge

K 1	types of signal converters such as D/A, A/D and current to pneumatic
K 2	wiring, tubing, and connections methods
K 3	potential causes of interference
K 4	standards and codes
K 5	features and limitations of signal converters such as accuracy and repeatability
K 6	grounding methods
K 7	configuration methods
K 8	signal converters that require calibration
K 9	calibration instruments such as multimeters and software
K 10	calibration methods and parameters
K 11	impact of calibration on process

Sub-task

F-18.01 Installs signal converters.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Key Competencies

F-18.01.01	select and use installation tools and equipment
F-18.01.02	select signal converter according to required functionality and environment
F-18.01.03	mount signal converters according to company standards and manufacturers' specifications
F-18.01.04	select wiring and/or tubing according to application requirements
F-18.01.05	terminate wiring and/or tubing according to company standards and manufacturers' specifications
F-18.01.06	configure signal converter to process requirements according to manufacturers' instructions
F-18.01.07	calibrate signal converter to required specifications
F-18.01.08	commission system to verify operation within specified parameters by using test equipment and procedures
F-18.01.09	back up and document configuration settings for future data recovery

Sub-task

F-18.02 Maintains signal converters.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Key Competencies

F-18.02.01	perform inspection to detect abnormalities such as leaks, loose connections and corrosion
F-18.02.02	perform function check of signal converters to confirm proper operation
F-18.02.03	follow manufacturers' recommended maintenance practices
F-18.02.04	clean devices to remove contamination

Sub-task

F-18.03 Diagnoses signal converters.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Key Competencies

F-18.03.01	select and use diagnostic tools and equipment such as multimeter and pressure calibrator
F-18.03.02	perform inspection to detect errors such as leaks, physical damage and faulty connections
F-18.03.03	check function of converters to isolate problems such as plugged relay and inadequate power
F-18.03.04	check switch configuration and adjustments
F-18.03.05	identify probable root cause and location of faults

Sub-task

F-18.04 Repairs signal converters.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Key Competencies

F-18.04.01	replace signal converters or components such as pneumatic relays and modules
F-18.04.02	clear plugged orifices
F-18.04.03	repair leaks using methods such as tightening fittings and replacing gaskets

Task 19 Installs and services data converters and gateways.

Context

Data converters and network gateways convert and buffer process information between two devices or systems. They are typically used where a large amount of information is exchanged. Instrumentation and control technicians install, configure, maintain, diagnose and repair these systems.

Required Knowledge

K 1	types of communication media such as fibre-optics and cabling
K 2	types of network, protocol and addressing structures
K 3	types of data converters and network gateways
K 4	programming such as data structure and format of both systems
K 5	limitations of network gateways and connected systems such as memory size and transmission speed

Sub-task

F-19.01 Installs data converters and network gateways.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Key Competencies

F-19.01.01	connect data converters and network gateways according to company standards and device limitations
F-19.01.02	select data converters and network gateways according to application requirements
F-19.01.03	select mounting location, mount and connect data converters and gateways according to company standards and device limitations
F-19.01.04	select cabling according to application requirements

Sub-task

F-19.02 **Configures data converters and network gateways.**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Key Competencies

F-19.02.01	select and use tools and equipment such as computer software and hardware
F-19.02.02	set protocols, addressing and port parameters according to company standards and documentation, and manufacturers' specifications
F-19.02.03	back up and document configuration settings for future data recovery

Sub-task

F-19.03 **Maintains data converters and network gateways.**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Key Competencies

F-19.03.01	check indicating lights and error counters to ensure basic network gateway operation
F-19.03.02	perform inspection to detect abnormalities such as heat build-up, humidity and contamination

Sub-task

F-19.04 **Diagnoses data converters and network gateways.**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Key Competencies

F-19.04.01	select and use diagnostic tools and equipment such as protocol analyzers and computer software
F-19.04.02	check indicating lights
F-19.04.03	verify configuration
F-19.04.04	compare a sample of data values between systems
F-19.04.05	determine response time of data transfer to identify abnormalities
F-19.04.06	identify probable root cause and location of faults

Sub-task

F-19.05 **Repairs data converters and network gateways.**

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Key Competencies

F-19.05.01	select and use tools and equipment such as computer and software
F-19.05.02	replace data converters and network gateways or components such as modules and circuit boards
F-19.05.03	restore and verify correct configuration

BLOCK G CONTROL SYSTEMS AND PROCESS CONTROL

Trends

As communication methods have evolved, the available data to the control system has increased. This increase can cause alarm saturation which, in turn, is driving the need for evaluation and prioritization of alarms.

Software design of process control strategies is a trend that is gaining popularity.

Programmable Logic Controllers (PLCs) can include Process Safety Systems (PSS) that provide increased redundancy and diagnostics to cover Safety Integrity Level (SIL) driven functionalities. PLCs are increasingly capable of DCS functionality and vice versa.

Because of increased availability and lower costs, PLCs are also being utilized for smaller control applications. Due to the increased diversity of available PLC products, company standardization of hardware and configurations is becoming an increased priority.

DCSs are becoming more capable of doing SCADA functions such as increased data acquisition. DCS systems are becoming more powerful and able to do more advanced trending and modeling. DCSs have become smaller and networked with multiple processors networked to a central processor.

SCADA systems are becoming more integrated into the measuring and control devices, becoming less of a stand-alone component.

With the improvements in computer technology, HMIs are increasingly capable of advanced programming, monitoring and trending.

Related Components (include, but not limited to)

Software, hardware, graphic interfaces, advanced control components, servers, UPS, communication networks and components, printers, faxes, automated paging systems and emergency alarm panels.

Hardware controllers, software controllers, measurement devices, final control devices, associated process equipment (such as compressors, boilers, pumps, mills).

SCADA: modems, wireless components (radios, satellite, microwave), PLC, DCS, Remote Terminal Unit (RTU), servers, computer equipment, alarm panels.

Tools and Equipment

See Appendix A.

Task 20 Establishes process control strategies.

Context Process control strategies are employed and selected to maintain and control the performance of the process. Instrumentation and control technicians determine and optimize these strategies.

Required Knowledge

K 1	process control strategies such as feed forward/back, cascade and ratio
K 2	controller functions such as direct/reverse action, auto/manual and split range
K 3	mathematical equations employed by strategies such as Proportional, Integral and Derivative (PID)
K 4	process to be controlled
K 5	control equipment characteristics and limitations
K 6	process control strategy limitations
K 7	manufacturers' equipment requirements
K 8	process requirements
K 9	configuration software
K 10	manufacturers' recommended configuration routines
K 11	process specific control strategies
K 12	interaction of other processes
K 13	failure modes
K 14	multi-variable control processes
K 15	tag descriptors and addressing

Sub-task

G-20.01 Determines process control strategy.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Key Competencies

G-20.01.01	determine process to be controlled, its requirements and limitations
G-20.01.02	determine control, process and manipulated variables based on process requirements
G-20.01.03	determine applicable control strategy such as cascade, selective and ratio

G-20.01.04	develop loop diagram as basis for implementation
G-20.01.05	determine controller action such as forward and reverse
G-20.01.06	determine controller mode such as PI and PID

Sub-task

G-20.02 Optimizes process control.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Key Competencies

G-20.02.01	initiate process control strategy for analysis
G-20.02.02	evaluate strategy's ability to control the process
G-20.02.03	initiate a change in the process to observe how the process control reacts to the change
G-20.02.04	gather process data to evaluate process stability and reactions
G-20.02.05	analyze data and observations to determine the effectiveness of the strategy
G-20.02.06	recognize control and process limitations
G-20.02.07	tune process according to analysis of the data and observations
G-20.02.08	utilize tuning software to obtain recommended settings

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Task 21 Installs and services stand-alone controllers (SACs).

Context SACs such as electronic or pneumatic controllers, employ control strategies. They usually control a specific portion of process or a single loop rather than an entire system or plant. They may be configured to receive remote set points.

Required Knowledge

K 1	types of SACs such as pneumatic, electronic and digital
K 2	controller functions such as direct/reverse action, auto/manual and split range
K 3	types of inputs and outputs such as pneumatic and electronic
K 4	connection methods
K 5	operation theory

K 6	operating parameters
K 7	installation conditions such as extreme ambient temperature, cleanliness and contamination
K 8	configuration techniques
K 9	configuration tools such as handheld programmers and software
K 10	control parameters and process limitations
K 11	calibration techniques applied to specific control strategies
K 12	calibration tools such as pneumatic test equipment, handheld programmers and software
K 13	desired process control and process control strategy
K 14	manufacturers' maintenance recommendations
K 15	tag descriptors and addressing

Sub-task

G-21.01 Installs SACs.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Key Competencies

G-21.01.01	select controller according to application, control strategy and signal requirements
G-21.01.02	determine mounting requirements and locations
G-21.01.03	select and use installation tools and equipment
G-21.01.04	connect wiring or tubing to controller according to schematics and manufacturers' recommendations
G-21.01.05	calibrate inputs/outputs (electronic and pneumatic) to verify readings and controls according to manufacturers' and loop specifications

Sub-task

G-21.02 Configures SACs.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Key Competencies

G-21.02.01	select and use tools, equipment and software for configuration according to manufacturers' recommendations
G-21.02.02	develop controller configuration by interpreting process control strategy
G-21.02.03	implement configuration
G-21.02.04	verify controller to determine if controller configuration controls the process according to operational requirements
G-21.02.05	back up and document configuration, settings and tuning parameters for future data recovery

Sub-task

G-21.03 Maintains SACs.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Key Competencies

G-21.03.01	select and use tools, equipment and software
G-21.03.02	select required maintenance materials such as filters and restrictors
G-21.03.03	isolate controller from process
G-21.03.04	perform controller alignment according to manufacturers' recommendations
G-21.03.05	upgrade software and firmware
G-21.03.06	return controller to service
G-21.03.07	back up and document upgrades for future data recovery

Sub-task

G-21.04 Diagnoses SACs.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Key Competencies

G-21.04.01	select and use diagnostic tools, equipment and software
G-21.04.02	verify operation and function of SACs
G-21.04.03	review settings such as configuration input, mode and set point, to assess the process control
G-21.04.04	identify deviations from normal operating parameters within process
G-21.04.05	identify probable root cause and location of faults

Sub-task

G-21.05 Repairs SACs.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Key Competencies

G-21.05.01	select and use repair tools, equipment and software
G-21.05.02	select replacement parts according to controller specifications and applications
G-21.05.03	disassemble SACs according to job procedures and manufacturers' recommendations
G-21.05.04	replace defective parts such as cards, chips, flappers, nozzles and relays
G-21.05.05	assemble SACs according to job procedure and manufacturers' recommendations
G-21.05.06	make required adjustments

Task 22 Installs and services programmable logic controllers (PLCs).

Context PLCs employ control strategies and user-created programs to control multiple loops and systems. These can be used individually or networked with other control systems to operate equipment and facilities efficiently and safely.

Required Knowledge

K 1	types of PLCs supplied by various manufacturers and the differences in their architecture and capabilities
K 2	programming software and version compatibility
K 3	languages such as ladder, function block, sequential function chart and script
K 4	types of components such as power supply, processor, memory and I/O
K 5	grounding methods
K 6	digital, discrete and analog signals
K 7	compatibility with other process control systems
K 8	communication networks and protocols
K 9	installation conditions such as heat, cleanliness and contamination
K 10	manufacturers' specifications and recommendations
K 11	associated software such as word processors, spreadsheets and databases
K 12	tag descriptors and addressing
K 13	configuration parameters
K 14	programming standards
K 15	alarm priorities
K 16	access and security levels
K 17	licensing and service contract requirements
K 18	controlled process
K 19	interaction with process
K 20	effects of maintenance actions or errors
K 21	communication systems used by PLCs
K 22	maintenance practices
K 23	software and hardware limitations
K 24	obsolescence issues
K 25	service bulletins and alerts
K 26	cause and effects of forcing and bypassing I/Os

K 27	data types such as binary, integer and floating point
K 28	hot standby and redundancy applications

Sub-task

G-22.01 Installs PLCs.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Key Competencies

G-22.01.01	determine PLC to be installed according to engineering specifications, application, control strategy and company standards
G-22.01.02	confirm installation details of PLC
G-22.01.03	select and use installation tools and equipment
G-22.01.04	mount racks and additional equipment according to drawings and common practices
G-22.01.05	connect wiring and network to PLC according to schematics, manufacturers' specifications and company standards

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Sub-task

G-22.02 Configures PLCs.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Key Competencies

G-22.02.01	select and use tools, equipment and software according to manufacturers' recommendations and company standards
G-22.02.02	input data by uploading and downloading PLC programs
G-22.02.03	update firmware
G-22.02.04	create and validate PLC configuration according to card and rack layout
G-22.02.05	program PLC, including comments, according to process control strategy and company standards
G-22.02.06	configure external communication with other systems and devices

G-22.02.07	verify configuration and programming to determine if PLC controls the process according to operational requirements
G-22.02.08	back and document programming, configuration, settings and parameters for future data recovery

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Sub-task

G-22.03 Maintains PLCs.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Key Competencies

G-22.03.01	select and use maintenance tools, equipment and software
G-22.03.02	review scan times, codes and logs to identify problem
G-22.03.03	perform inspection by checking indicating lights verifying environmental conditions such as temperature and cleanliness
G-22.03.04	perform regular maintenance such as replacing back-up batteries and cleaning fans and filters

---

Sub-task

G-22.04 Diagnoses PLCs.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Key Competencies

G-22.04.01	use diagnostic tools and software
G-22.04.02	investigate symptoms and conditions causing the problem
G-22.04.03	review error codes, logs and status lights to isolate problem
G-22.04.04	perform diagnostic procedures such as forcing I/O, setting traps and counters
G-22.04.05	check PLC programming and configuration
G-22.04.06	interpret self-diagnostic and alarm indicators
G-22.04.07	identify probable root cause and location of faults

Sub-task

G-22.05 Repairs PLCs.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Key Competencies

G-22.05.01	select and use diagnostic tools and software
G-22.05.02	replace defective components such as cards, racks and power supplies
G-22.05.03	restore program and configuration from back-up
G-22.05.04	correct PLC program and configuration errors
G-22.05.05	back up and document PLC program and configuration for future data recovery

Task 23 Installs and services distributed control systems (DCSs).

Context DCSs employ control strategies and user-created programs to control multiple loops and systems. They usually incorporate their own operator interface functionality or graphical user station. DCSs are specifically designed to have their own remote I/O drops.

Required Knowledge

K 1	types of DCSs, their architecture and their capabilities
K 2	languages such as function block and script
K 3	types of components such as power supply, server, processor, memory and I/O
K 4	cabling and grounding methods
K 5	digital, discrete and analog signals
K 6	compatibility with other process control systems
K 7	communication networks and protocols
K 8	installation conditions such as heat, cleanliness and contamination
K 9	manufacturers' specifications and recommendations
K 10	DCS programs and associated software such as word processors, spreadsheets and databases
K 11	tag descriptors and addressing

K 12	configuration parameters
K 13	programming consistency issues
K 14	alarm priorities
K 15	access and security levels
K 16	licensing and service contract requirements
K 17	manufacturers' maintenance recommendations
K 18	controlled process
K 19	interaction with process
K 20	effects of maintenance actions or errors
K 21	software and hardware limitations
K 22	service bulletins and alerts
K 23	cause and effects of forcing, disabling and bypassing I/Os

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Sub-task

G-23.01 Installs DCSs.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Key Competencies

G-23.01.01	confirm installation details of DCS components such as cabinets, operator stations and servers according to engineering specifications and company standards
G-23.01.02	select and use installation tools and equipment
G-23.01.03	place cabinets, monitors and operator stations according to drawings and company requirements
G-23.01.04	select and install DCS components such as I/O cards and power supplies
G-23.01.05	connect wiring and network to DCS according to schematics, manufacturers' recommendations and company standards

Sub-task

G-23.02 Configures DCSs.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Key Competencies

G-23.02.01	select and use tools, equipment and software for configuration according to manufacturers' recommendations and company standards
G-23.02.02	update operating software if required
G-23.02.03	create and validate DCS configuration according to rack and cabinet layout
G-23.02.04	program DCS, including comments and displays, according to process control strategy and company standards
G-23.02.05	configure external communication with other systems and devices
G-23.02.06	back up and restore configurations
G-23.02.07	verify that the DCS configuration and programming controls the process according to operational requirements
G-23.02.08	back up and document configuration, settings and parameters for future data recovery

Sub-task

G-23.03 Maintains DCSs.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Key Competencies

G-23.03.01	select and use maintenance tools, equipment and software
G-23.03.02	review scan times, codes and logs to identify problems
G-23.03.03	perform inspection by checking indicating lights
G-23.03.04	check environmental conditions such as ambient temperature and cleanliness
G-23.03.05	perform regular maintenance such as cleaning fans and filters, and replacing back-up batteries according to manufacturers' maintenance schedule and company standards
G-23.03.06	back up and document DCS program and servers for future data recovery

Sub-task

G-23.04 Diagnoses DCSs.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Key Competencies

G-23.04.01	select and use diagnostic tools and software
G-23.04.02	check DCS operations to identify network and communication problems
G-23.04.03	review scan times, error codes, logs and status lights to identify problems
G-23.04.04	perform diagnostic procedures such as forcing I/O, setting traps and counters
G-23.04.05	check power supply for proper voltage level
G-23.04.06	run and interpret self-diagnostic and alarm indicators
G-23.04.07	identify probable root cause and location of faults

Sub-task

G-23.05 Repairs DCSs.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Key Competencies

G-23.05.01	select and use repair tools and software
G-23.05.02	replace components such as cards, racks, communication components and power supplies
G-23.05.03	correct DCS program and configuration errors

Task 24 Installs and services Supervisory Control and Data Acquisition (SCADA) systems.

Context

SCADA systems are data transmission and acquisition systems for remote control and monitoring of equipment and facilities. They can be used for local control applications such as remote shut-downs and start-ups of plant equipment. They may have the added ability to store, measure, trend and manipulate data for reporting purposes.

Required Knowledge

K 1	types of SCADA protocols and configurations
K 2	SCADA theory
K 3	SCADA equipment such as RTUs, PLCs, HMIs, DCSs, communication systems and interconnection media
K 4	wireless SCADA system components such as satellite, radio and microwave
K 5	servers for data acquisition and storage
K 6	connection methods such as hardwired and wireless
K 7	potential causes of interference
K 8	standards, codes and licences
K 9	alarm priorities
K 10	features and limitations of protocols and programming languages
K 11	grounding methods
K 12	configuration methods
K 13	network layout
K 14	addressing methods and components
K 15	location selection for wireless transmission towers and antennas
K 16	communication protocols such as MODBUS, Profibus and TCP/IP
K 17	SCADA processes and system interactions
K 18	required wireless signal strength and settings
K 19	time synchronization and time stamping
K 20	configuration licensing
K 21	interaction of complete system
K 22	tag descriptors and addressing

Sub-task

G-24.01 Installs SCADA systems.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Key Competencies

G-24.01.01	identify SCADA equipment according to engineering specifications, application, control strategy and company standards
G-24.01.02	confirm installation details of SCADA equipment
G-24.01.03	select and use installation tools and equipment
G-24.01.04	mount SCADA components according to drawings and common practices
G-24.01.05	terminate wiring and network to SCADA equipment according to schematics, manufacturers' recommendations and company standards
G-24.01.06	mount and test wireless transmission towers

Sub-task

G-24.02 Configures SCADA systems.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Key Competencies

G-24.02.01	select and use tools, equipment and software for configuration according to manufacturers' recommendations and company standards
G-24.02.02	create and validate SCADA configuration, including comments, according to application and company standards
G-24.02.03	upload and download SCADA configurations/database
G-24.02.04	update software and firmware as required
G-24.02.05	configure external communication with other systems and devices
G-24.02.06	back up and restore configurations to ensure future recovery
G-24.02.07	determine if SCADA configuration and programming monitors and/or controls the process according to operational requirements
G-24.02.08	document configuration, settings and parameters
G-24.02.09	avoid interference with other systems and processes

Sub-task

G-24.03 Maintains SCADA systems.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Key Competencies

G-24.03.01	select and use maintenance tools, equipment and software
G-24.03.02	manipulate process to allow for maintenance
G-24.03.03	review scan times, and possible error codes and logs
G-24.03.04	perform inspection, checking indicating lights and verifying environmental conditions such as ambient temperature and cleanliness
G-24.03.05	follow manufacturers' regular maintenance schedule such as replacing back-up batteries
G-24.03.06	clean SCADA components such as solar panels and satellite dishes

Sub-task

G-24.04 Diagnoses SCADA systems.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Key Competencies

G-24.04.01	select and use diagnostic tools and software
G-24.04.02	identify installation problems and deficiencies
G-24.04.03	review error codes, logs and status lights to isolate problem
G-24.04.04	use diagnostic procedures such as forcing I/O and setting traps and counters
G-24.04.05	check power source for proper voltage level
G-24.04.06	run and interpret self-diagnostic and alarm indicators
G-24.04.07	test wireless signal strength
G-24.04.08	identify probable root cause and location of faults

Sub-task

G-24.05 Repairs SCADA systems.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Key Competencies

G-24.05.01	select and use repair tools and software
G-24.05.02	replace components such as I/O modules, servers and power supplies
G-24.05.03	restore configuration from back-up
G-24.05.04	correct faulty or changed logic

Task 25 Installs and services human machine interfaces (HMIs).

Context

HMIs interface with the controlling devices such as PLC, DCS and SCADA in order to allow monitoring and controlling of the process through graphical displays. HMIs often have the ability to provide trending, alarm summaries and historical data collection.

Required Knowledge

K 1	types of HMI software and hardware, design and capabilities
K 2	digital, discrete and analog signals
K 3	compatibility with other process control systems
K 4	communication networks and protocols
K 5	installation conditions such as heat, cleanliness and contamination
K 6	software/hardware manufacturers' specifications and recommendations
K 7	HMI programs and associated software such as word processors, spreadsheets and databases
K 8	tag descriptors and addressing
K 9	configuration parameters
K 10	programming consistency issues
K 11	alarm priorities
K 12	read/write issues
K 13	access and security levels

K 14	controlled process
K 15	interaction with PLC or DCS systems
K 16	effects of maintenance actions or errors
K 17	software limitations
K 18	licensing and service contract requirements

Sub-task

G-25.01 Installs HMIs.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Key Competencies

G-25.01.01	determine HMI according to engineering specifications, application, control strategy and company standards
G-25.01.02	confirm installation details of HMI
G-25.01.03	select and use installation tools and equipment
G-25.01.04	mount HMI components according to drawings and common practices
G-25.01.05	connect cabling and network to HMI according to schematics, manufacturers' recommendations and company standards

---

Sub-task

G-25.02 Configures HMIs.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Key Competencies

G-25.02.01	select and use tools, equipment and software for configuration according to manufacturers' recommendations and company standards
G-25.02.02	update software and firmware
G-25.02.03	create and validate HMI configuration, including information such as depiction of process control strategy and equipment statuses
G-25.02.04	configure external communication with other systems and devices
G-25.02.05	back up and restore configurations

G-25.02.06	verify that the HMI configuration and programming interfaces with the process variables
G-25.02.07	commission to determine if HMI configuration and programming controls the process according to operational requirements
G-25.02.08	back up and document HMI configuration, settings and parameters for future data recovery

---

Sub-task

G-25.03 Maintains HMIs.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Key Competencies

G-25.03.01	select and use maintenance tools, equipment and software
G-25.03.02	review status lights, scan times, codes and logs to identify problems
G-25.03.03	perform inspection, checking indicating lights and verifying environmental conditions such as ambient temperature and cleanliness
G-25.03.04	clean defective components such as fans, filters and screens
G-25.03.05	follow manufacturers' regular maintenance schedule
G-25.03.06	back up and document HMI program and configuration for future data recovery

---

Sub-task

G-25.04 Diagnoses HMIs.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Key Competencies

G-25.04.01	use diagnostic tools and software
G-25.04.02	review scan times, codes, logs and status lights to isolate problem
G-25.04.03	perform diagnostic procedures such as forcing I/O and manipulating process variables

G-25.04.04	check power source to confirm quality
G-25.04.05	identify probable root cause and location of faults

---

Sub-task

G-25.05 Repairs HMIs.

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	yes	yes	ND	yes	yes	yes	yes	yes	NV	NV	NV

Key Competencies

G-25.05.01	select and use repair tools and software
G-25.05.02	replace components such as displays, hardware, software and operating system
G-25.05.03	correct HMI program and configuration errors
G-25.05.04	back up and document HMI program and configuration for future data recovery

APPENDICES

APPENDIX A TOOLS AND EQUIPMENT

Hand Tools

calipers (assorted)
desoldering tool
diagonal cutters
drill bits
easy-outs (extractors)
feeler gauges
flaring tools
flashlight
fuse puller
gasket cutter
gauge pointer puller
grease gun
hammers (assorted)
hand files (assorted)
hex keys (Imperial/Metric)
hexalobular wrench (Torx)
I/C Integrated-circuit extractor
knives
knock out punches
level
magnet
measuring tape
micrometers (assorted)
mirrors
nut drivers (assorted)
packing puller
pipe threader
pliers (assorted)
prybar
punches (assorted)
reamers
rubber mallet
saws (assorted)
screw starters
screwdrivers (assorted)
scribers
sockets (Imperial/Metric)
square
steel rule
strap wrenches
tap and die set
torch
torque wrench
tube benders
tube cutters
tweezers
wire brushes
wire crimpers
wire cutters
wire strippers
wrenches (assorted)

Power Tools

air compressor
band saw
cutoff saw
drill press
grinders
hammer drill
heat gun
high pressure grease gun
hydraulic press
impact wrench
jig saw
pipe threader
pneumatic tools
portable electric drill
portable generator
powder-actuated tools
pressure and vacuum pumps
reciprocating saw
sandblaster
soldering iron
wire labeler

Electronic Tools and Test Equipment

amp probe
analog multimeter
analogue signature analyzer
analyzers
barometer
breakout box
bridges
calibrated oven
capacitance simulators
computer (laptop or desktop and PDA)
current tracer
deadweight tester
decade resistance box
dew point testers (assorted)
digital logic probe
digital multimeter
dry block calibrator
frequency counter
frequency generator
grounding mats
handheld programmer (configurators)
hydrometer
infrared cameras
infrared thermometers
lab scales
laser strength meter
light microscopes
logic clip
loop calibrator/simulator
manometer and standards
microwave leakage meter
millivoltmeter calibrator
mobile phones/pagers/two-way radio
null balance strain indicator
oscilloscope
pH simulator/buffers
pneumatic test stand
portable sound level meter
pressure pump
proximity voltage tester
power supply
pressure calibrator
protocol analyzers
radiation meters
regulators
RPM tester/tachometer
RTD (resistive thermal device)
thermocouple calibrator
signal generators
signature analyzer
sling psychrometer
stroboscope
temperature bath
test gases
test gauges
thermometer
transistor checker
ultrasonic strap on flowmeter
vacuum pumps
variable transformer
vibration table (wobbulator)
wireless signal strength tester
wrist ground strap

Access, Work Holding Equipment and Lifting and Hoisting Equipment

bucket truck
C-clamps
chain fall
come-along
crane (overhead, portable)
forklift
hoist basket
ladders
portable cart
prefabricated scaffold
scissor lift
self-powered elevated work platform
slings
vises (assorted)

PPE and Safety Equipment

apron
cap lamps
coveralls (regular, disposable and fireproof)
ear protection (muffs and plugs)
eye wash bottle
face shield
fall arrest harness
fire extinguishers
first aid kit
flame retardant clothing
gloves
hard hat
low-voltage gloves
mask (assorted)
personal dosimeter
personal monitor (gas)
radiation survey metre
radiometer
respirators
rubber boots
rubber suits
safety boots
safety glasses
safety lanyards
safety lines
self-contained breathing apparatus
goggles
supplied air hood
winter gear

APPENDIX B GLOSSARY

actuator	a controlled hardware device used to implement change in a process
adapter	a device used to make electrical or mechanical connections between items not originally intended for use together
amplifier	a device that enables an input signal to control power from a source independent of the signal and thus be capable of delivering an output that bears some relationship to, and is generally greater than, the input signal
analog signal	any variable signal continuous in both time and amplitude rather than of a pulsed or discrete nature
bellows	a mechanical element of generally cylindrical shape with cylindrical walls containing deep convolutions
benchset	removing a piece of equipment and testing it at the shop; a static setup as opposed to a dynamic setup; this term typically refers to a preload or the amount of pressure forcing valves closed with no process affecting it
calibrate	to determine, by measurement or comparison with a standard, the correct value of each scale reading on a meter or other device
cascade control	a type of controller set-up in which the output of one controller acts as the set point or controlling signal of another controller
configure	to set up a program or computer system for a particular application
control mode	a specific type of control action such as proportional, integral or derivative
control variable	measured variables that can be manipulated by the control system, such as flow, level, pressure and temperature
diagnose	activities to determine the cause and source of faults and defects
digital bus transmission	exchanging signals and information between system components by means of voltage or current that fluctuate between two levels; these signals represent binary numbers that are interpreted as values
distributed control system (DCS)	a system of dividing plant or process control into several areas of responsibility, each managed by its own controller (processor), with the whole interconnected to form a single entity usually by communication buses of various kinds

feed forward	an industry standard process control strategy, in which mathematically predicted errors are corrected before they occur
fibre optic	a transmission system utilizing hair-thin glass fibres through which light is transmitted. Information is transferred by modulating the transmitted light
Fieldbus	a digital, two-way, multi-drop communication link among intelligent measurement and control devices. It serves as a Local Area Network (LAN) for advanced process control, remote input/output and high speed factory automation applications. a communication protocol
firmware	software (programs or data) that has been written onto read-only memory chips. Firmware is a combination of software and hardware
flume	an open channel device used to measure largest flow rates
frequency	the number of cycles completed by a periodic quantity on a unit time
Highway Addressable Remote Transducer (HART)	provides digital communication to microprocessor-based (smart) analog process control instruments. a communication protocol
Human Machine Interface (HMI)	the graphical display and control interface between a process and a human operator
input/output (I/O)	all equipment and activity that transfers information into or out of a computer. the transfer of data between the main storage and other devices, such as the transmitter DCS PLC
install	activities performed which include mounting, process connecting (to process and control systems) and commissioning equipment or systems
instrumentation	a collection of instruments or their application for the purpose of observation, measurement or control
Instrumentation, Systems and Automation Society (ISA)	an engineering society that develops and maintains defined standards for both scientific and technical areas of process control and automation

interface	the place at which systems, such as a computer and a peripheral, meet and interact with each other
kinetic	the energy that a body possesses as a result of its motion
maintain	routine preventative activities performed to ensure reliability and to detect potential faults
module	an assembly of interconnected components which constitutes an identifiable device, instrument or piece of equipment — can be removed, tested as a unit and replaced with a spare
network	the interconnection of devices sharing a communications protocol
optimize	a series of activities performed to make the process and its control function close to or better than specification.
port	a signal input (access) or output (egress) point
power supply	a device that produces one or more voltages for the operation of electronic and logic devices.
process	physical or chemical change of matter or conversion of energy such as change in pressure, temperature, speed, electrical potential, etc.
Profibus	a communication protocol
program	a list of instructions that a computer will execute to perform a certain task
Programmable Logic Controller (PLC)	a control device, normally used in industrial control applications that employs the hardware architecture of a computer and a relay ladder diagram language
Proportional Integral Derivative (PID)	proportional gain, integral action time and derivative action time. PID software, for example, compares an analog input value with a set point and if there's a discrepancy outputs an appropriate analog or digital control value, according the PID calculations
range	the region between the limits within which a quantity is measured, received or transmitted; expressed by stating the lower and upper range values
ratio	the quotient of one quantity divided by another
remote	a device allowing the set point to be altered by a signal from a physical location away from the controller — necessary for cascade operation

repair	activities performed to correct faults; include cleaning, replacing, rebuilding
Safety Integrity Level (SIL)	Safety Instrumented System (SIS)/Process Safety System (PSS)
sensing element	the element directly responsive to the value of the measured variable
signal	a form of energy that quantitatively represents a variable
strain gauge	a device that uses the change of electrical resistance of a wire under strain to measure applied force
Supervisory Control and Data Acquisition (SCADA)	a control package used to monitor and control a remote process; also includes hardware such as modems, telemetry, servers and control systems
telemetry	transmitting the readings of instruments to a remote location by means of wires, radio waves or other means
temperature bath	a volume of a substance held at constant temperature, so that an object placed in thermal contact with it is maintained at the same temperature
terminal	a peripheral device used by the operator to communicate with the computer or a wire connection
thermocouple	devices that convert heat energy into electrical energy consisting of two dissimilar metal strips fused together at one end
transducer	an element or device that receives energy in one form and converts to another form
transmitter	a transducer which responds to a measured variable by means of a sensing element, and converts it to a standardized transmission signal that is proportional to the measured variable
tuning	adjustment of parameters to optimize a particular process
Uninterruptible Power Supply (UPS)	used to keep critical equipment, including computers, running in the event of a power failure

Variable Frequency Drive (VFD) and Variable Speed Drive (VSD)	electronic equipment that allows an electric motor to be run at varying speeds
weir	an engineered obstruction placed in an open channel
wireless	noting or pertaining to any of various devices that are operated with or actuated by electromagnetic waves

APPENDIX C ACRONYMS

A/D	Analog to Digital
CEC	Canadian Electrical Code
CEM	Continuous Emissions Monitoring
CSA	Canadian Standards Association
D/A	Digital to Analog
DCS	Distributed Control System
HART	Highway Addressable Remote Transducer
HMI	Human Machine Interface
I/O	input/output
ISA	International Society of Automation or Instrumentation, Systems and Automation Society
OH&S	Occupational Health and Safety Act
OPC	OLE (Object Linking Embedding) Process Control
ORP	Oxidation Reduction Potential
PID	Proportional, Integral, Derivative
PLC	Programmable Logic Controller
PPE	Personal Protection Equipment
PSS	Process Safety Systems
RTD	Resistive Thermal Device
RTU	Remote Terminal Unit
SAC	Stand-Alone Controller
SCADA	Supervisory Control and Data Acquisition
SIL	Safety Integrity Level

SIS	Safety Instrumented System
TCP/IP	Transport Control Protocol/Internet Protocol
TDG	Transportation of Dangerous Goods
UPS	Uninterruptible Power Supply
VFD	Variable Frequency Drive
VSD	Variable Speed Drive
WHMIS	Workplace Hazardous Materials Information System

APPENDIX D BLOCK AND TASK WEIGHTING

BLOCK A OCCUPATIONAL SKILLS

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	National Average
%	10	9	5	10	ND	5	5	5	5	5	NV	NV	NV	6%

Task 1 Organizes work.

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	
%	20	50	60	50	ND	50	50	50	40	70	NV	NV	NV	49%

Task 2 Performs routine trade activities.

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	
%	80	50	40	50	ND	50	50	50	60	30	NV	NV	NV	51%

BLOCK B PROCESS MEASURING AND INDICATING DEVICES

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	National Average
%	40	23	25	20	ND	25	30	20	35	15	NV	NV	NV	26%

Task 3 Installs and services pressure, temperature, level and flow measuring and indicating devices.

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	
%	30	40	60	30	ND	48	20	20	50	20	NV	NV	NV	35%

Task 4 Installs and services motion, speed, position and vibration measuring and indicating devices.

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	
%	10	15	10	20	ND	20	20	20	10	20	NV	NV	NV	16%

Task 5 Installs and services mass, density and consistency measuring and indicating devices.

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	
%	20	10	10	20	ND	8	20	20	10	20	NV	NV	NV	15%

Task 6 Installs and services process analyzers.

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	
%	30	20	10	15	ND	16	20	20	20	20	NV	NV	NV	19%

Task 7 Installs and services flow computing devices.

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	
%	10	15	10	15	ND	8	20	20	10	20	NV	NV	NV	15%

BLOCK C SAFETY AND SECURITY SYSTEMS AND DEVICES

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	National Average
%	5	8	5	10	ND	5	10	10	5	10	NV	NV	NV	7%

Task 8 Installs and services safety systems and devices.

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	
%	80	100	90	50	ND	66	60	100	100	65	NV	NV	NV	79%

Task 9 Installs and services security systems. (NOT COMMON CORE)

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	
%	20	0	10	50	ND	34	40	0	0	35	NV	NV	NV	21%

BLOCK D HYDRAULIC, PNEUMATIC AND ELECTRICAL SYSTEMS

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	National Average
%	5	13	5	15	ND	7	5	15	5	20	NV	NV	NV	10%

Task 10 Installs and services hydraulic equipment.

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	
%	15	40	10	50	ND	25	20	25	10	30	NV	NV	NV	25%

Task 11 Installs and services pneumatic equipment.

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	
%	70	40	40	20	ND	38	40	50	50	45	NV	NV	NV	44%

Task 12 Installs and services electrical equipment.

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
%	15	20	50	30	ND	37	40	25	40	25	NV	NV	NV

31%

BLOCK E FINAL CONTROL DEVICES

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	National Average
%	20	19	20	20	ND	23	30	20	15	20	NV	NV	NV	21%

Task 13 Installs and services valves.

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
%	30	28	10	25	ND	22	25	40	35	30	NV	NV	NV

27%

Task 14 Installs and services actuators.

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
%	30	28	30	25	ND	39	25	20	25	30	NV	NV	NV

28%

Task 15 Installs and services positioners.

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
%	30	28	30	25	ND	39	25	30	30	30	NV	NV	NV

30%

Task 16 Services variable speed drives (VSD).

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
%	10	16	30	25	ND	0	25	10	10	10	NV	NV	NV

15%

BLOCK F COMMUNICATION SYSTEMS AND DEVICES

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	National Average
%	5	11	10	10	ND	15	10	15	10	10	NV	NV	NV	11%

Task 17 Installs and services network and signal transmission systems.

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
%	70	25	35	35	ND	33	33	35	25	30	NV	NV	NV

36%

Task 18 Installs and services signal converters.

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	
%	20	40	35	35	ND	47	33	45	50	30	NV	NV	NV	37%

Task 19 Installs and services data converters and gateways.

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	
%	10	35	30	30	ND	20	34	20	25	40	NV	NV	NV	27%

BLOCK G CONTROL SYSTEMS AND PROCESS CONTROL

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	National Average
%	15	17	30	15	ND	20	10	15	25	20	NV	NV	NV	19%

Task 20 Establishes process control strategies.

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	
%	10	10	5	16	ND	25	20	25	10	20	NV	NV	NV	15%

Task 21 Installs and services stand-alone controllers (SACs).

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	
%	10	15	20	16	ND	10	10	15	15	20	NV	NV	NV	14%

Task 22 Installs and services programmable logic controllers (PLCs).

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	
%	10	20	25	25	ND	25	20	15	30	20	NV	NV	NV	21%

Task 23 Installs and services distributed control systems (DCSs).

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	
%	50	20	25	20	ND	25	20	20	30	20	NV	NV	NV	26%

Task 24 Installs and services Supervisory Control and Data Acquisition (SCADA) systems.

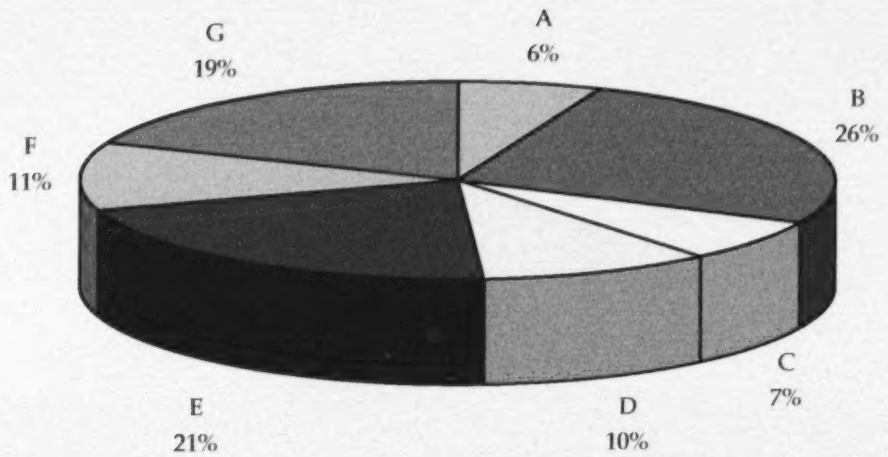
	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	
%	10	20	20	12	ND	5	20	15	10	10	NV	NV	NV	14%

Task 25 Installs and services human machine interfaces (HMIs).

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU	
%	10	15	5	11	ND	10	10	10	5	10	NV	NV	NV	10%

APPENDIX E

PIE CHART *



TITLES OF BLOCKS

BLOCK A	Occupational Skills	BLOCK E	Final Control Devices
BLOCK B	Process Measuring and Indicating Devices	BLOCK F	Communication Systems and Devices
BLOCK C	Safety and Security Systems and Devices	BLOCK G	Control Systems and Process Control
BLOCK D	Hydraulic, Pneumatic and Electrical Systems		

*Average percentage of the total number of questions on an interprovincial examination, assigned to assess each block of the analysis, as derived from the collective input from workers within the occupation from all areas of Canada. Interprovincial examinations typically have from 100 to 150 multiple-choice questions.

APPENDIX F

TASK PROFILE CHART — INSTRUMENTATION AND CONTROL TECHNICIAN

BLOCKS	TASKS	SUB-TASKS				
A - OCCUPATIONAL SKILLS	1. Organizes work.	1.01 Uses drawings and schematics.	1.02 Plans tasks.	1.03 Maintains safe work environment.		
	2. Performs routine trade activities.	2.01 Uses personal protective equipment (PPE) and safety equipment.	2.02 Performs de-energizing, lockout and tag-out procedures.	2.03 Maintains calibration, configuration and test equipment.	2.04 Maintains tools.	2.05 Operates material handling equipment.
B - PROCESS MEASURING AND INDICATING DEVICES	3. Installs and services pressure, temperature, level and flow measuring and indicating devices.	3.01 Installs pressure, temperature, level and flow measuring and indicating devices.	3.02 Maintains pressure, temperature, level and flow measuring and indicating devices.	3.03 Diagnoses pressure, temperature, level and flow measuring and indicating devices.	3.04 Repairs pressure, temperature, level and flow measuring and indicating devices.	
	4. Installs and services motion, speed, position and vibration measuring and indicating devices.	4.01 Installs motion, speed, position and vibration measuring and indicating devices.	4.02 Maintains motion, speed, position and vibration measuring and indicating devices.	4.03 Diagnoses motion, speed, position and vibration measuring and indicating devices.	4.04 Repairs motion, speed, position and vibration measuring and indicating devices.	
	5. Installs and services mass, density and consistency measuring and indicating devices.	5.01 Installs mass, density and consistency measuring and indicating devices.	5.02 Maintains mass, density and consistency measuring and indicating devices.	5.03 Diagnoses mass, density and consistency measuring and indicating devices.	5.04 Repairs mass, density and consistency measuring and indicating devices.	

BLOCKS	TASKS	SUB-TASKS			
	6. Installs and services process analyzers.	6.01 Installs process analyzers.	6.02 Maintains process analyzers.	6.03 Diagnoses process analyzers.	6.04 Repairs process analyzers.
	7. Installs and services flow computing devices.	7.01 Installs flow computing devices.	7.02 Maintains flow computing devices.	7.03 Diagnoses flow computing devices.	7.04 Repairs flow computing devices.
C - SAFETY AND SECURITY SYSTEMS AND DEVICES	8. Installs and services safety systems and devices.	8.01 Installs safety systems and devices.	8.02 Maintains safety systems and devices.	8.03 Diagnoses safety systems and devices.	8.04 Repairs safety systems and devices.
	9. Installs and services security systems. **(NOT COMMON CORE)**	9.01 Installs security systems. **(NOT COMMON CORE)**	9.02 Maintains security systems. **(NOT COMMON CORE)**	9.03 Diagnoses security systems. **(NOT COMMON CORE)**	9.04 Repairs security systems. **(NOT COMMON CORE)**
D - HYDRAULIC, PNEUMATIC AND ELECTRICAL SYSTEMS	10. Installs and services hydraulic equipment.	10.01 Installs hydraulic equipment. **(NOT COMMON CORE)**	10.02 Maintains hydraulic equipment.	10.03 Diagnoses hydraulic equipment.	10.04 Repairs hydraulic equipment.
	11. Installs and services pneumatic equipment.	11.01 Installs pneumatic equipment.	11.02 Maintains pneumatic equipment.	11.03 Diagnoses pneumatic equipment.	11.04 Repairs pneumatic equipment.
	12. Installs and services electrical equipment.	12.01 Installs electrical equipment.	12.02 Maintains electrical equipment.	12.03 Diagnoses electrical equipment.	12.04 Repairs electrical equipment.
E - FINAL CONTROL DEVICES	13. Installs and services valves.	13.01 Installs valves.	13.02 Maintains valves.	13.03 Diagnoses valves.	13.04 Repairs valves.

BLOCKS	TASKS	SUB-TASKS				
	14. Installs and services actuators.	14.01 Installs actuators.	14.02 Maintains actuators.	14.03 Diagnoses actuators.	14.04 Repairs actuators.	
	15. Installs and services positioners.	15.01 Installs positioners.	15.02 Maintains positioners.	15.03 Diagnoses positioners.	15.04 Repairs positioners.	
	16. Services variable speed drives (VSD).	16.01 Installs VSDs. **(NOT COMMON CORE)**	16.02 Maintains VSDs.	16.03 Diagnoses VSDs.	16.04 Repairs VSDs. **(NOT COMMON CORE)**	
F- COMMUNICATION SYSTEMS AND DEVICES	17. Installs and services network and signal transmission systems.	17.01 Installs network and signal transmission systems.	17.02 Configures network and signal transmission systems.	17.03 Maintains network and signal transmission systems.	17.04 Diagnoses network and signal transmission systems.	17.05 Repairs network and signal transmission systems.
	18. Installs and services signal converters.	18.01 Installs signal converters.	18.02 Maintains signal converters.	18.03 Diagnoses signal converters.	18.04 Repairs signal converters.	
	19. Installs and services data converters and gateways.	19.01 Installs data converters and network gateways.	19.02 Configures data converters and network gateways.	19.03 Maintains data converters and network gateways.	19.04 Diagnoses data converters and network gateways.	19.05 Repairs data converters and network gateways.
G- CONTROL SYSTEMS AND PROCESS CONTROL	20. Establishes process control strategies.	20.01 Determines process control strategy.	20.02 Optimizes process control.			
	21. Installs and services stand-alone controllers (SACs).	21.01 Installs SACs.	21.02 Configures SACs.	21.03 Maintains SACs.	21.04 Diagnoses SACs.	21.05 Repairs SACs.

BLOCKS	TASKS	SUB-TASKS				
	22. Installs and services programmable logic controllers (PLCs).	22.01 Installs PLCs.	22.02 Configures PLCs.	22.03 Maintains PLCs.	22.04 Diagnoses PLCs.	22.05 Repairs PLCs.
	23. Installs and services distributed control systems (DCSs).	23.01 Installs DCSs.	23.02 Configures DCSs.	23.03 Maintains DCSs.	23.04 Diagnoses DCSs.	23.05 Repairs DCSs.
	24. Installs and services Supervisory Control and Data Acquisition (SCADA) systems.	24.01 Installs SCADA systems.	24.02 Configures SCADA systems.	24.03 Maintains SCADA systems.	24.04 Diagnoses SCADA systems.	24.05 Repairs SCADA systems.
	25. Installs and services human machine interfaces (HMIs).	25.01 Installs HMIs.	25.02 Configures HMIs.	25.03 Maintains HMIs.	25.04 Diagnoses HMIs.	25.05 Repairs HMIs.